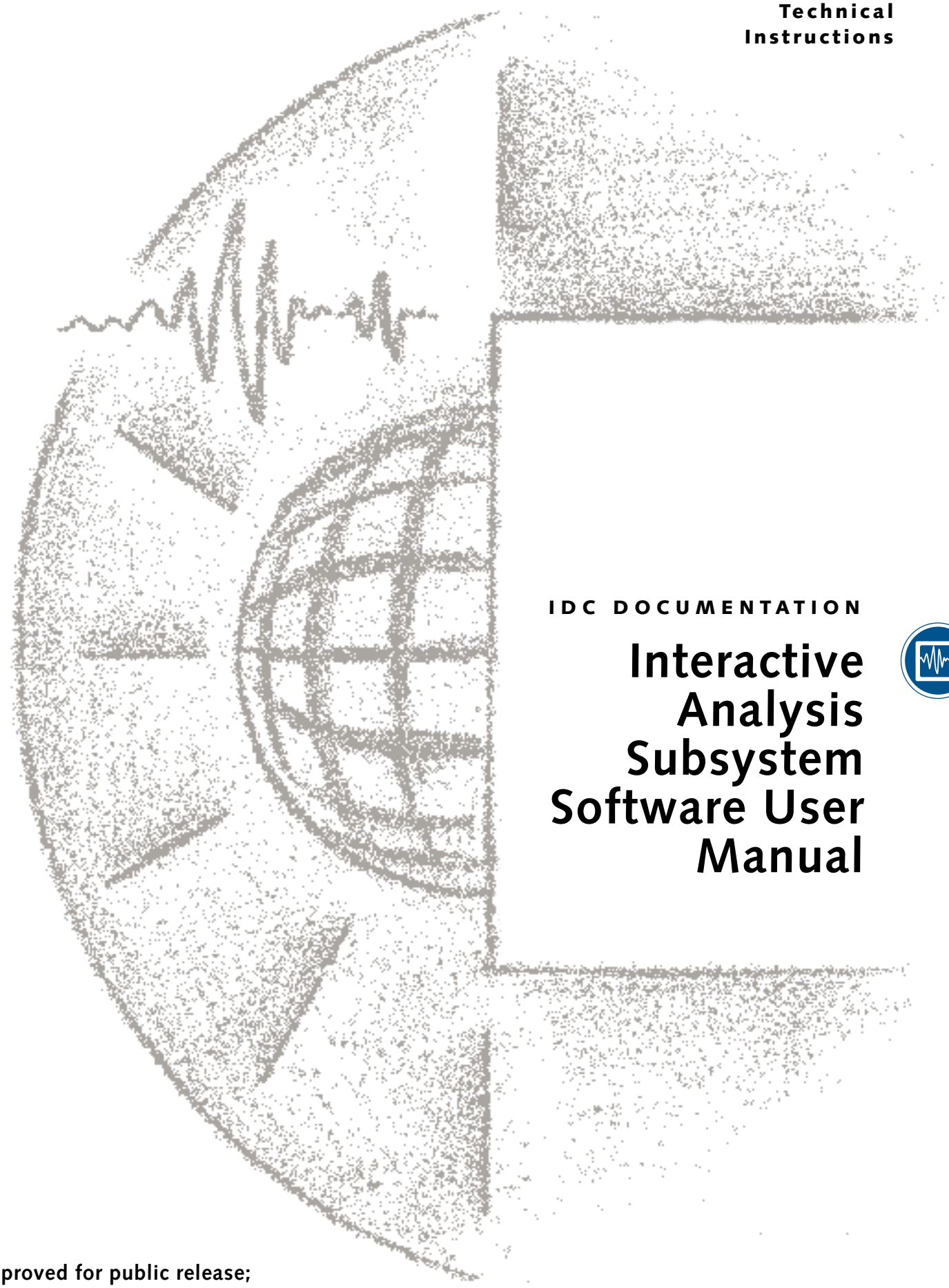
Technical Instructions



IDC DOCUMENTATION

Interactive Analysis Subsystem Software User Manual

Approved for public release; distribution unlimited

Notice

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About this Document

This chapter describes the organization and content of the document and includes the following topics:

- Purpose
- Scope
- Audience
- Related Information
- Using this Document

About this Document

PURPOSE

This document describes how to use the Interactive Analysis Subsystem of the International Data Centre (IDC). This software is part of the Time-Series Analysis computer software component (CSC) of the Interactive Processing Computer Software Configuration Item (CSCI).

SCOPE

The manual includes instructions for setting up the software, using its features, and basic troubleshooting. This document does not describe the software's design or requirements. Some of these topics are described in sources cited in "Related Information."

AUDIENCE

This document is intended for first-time or occasional users of the software. However, more experienced users may find certain sections useful as a reference. The word "you" in this document refers to an analyst of seismic/hydroacoustic/infrasonic (S/H/I) data.

RELATED INFORMATION

The following documents complement this document:

- *Database Schema* [IDC5.1.1Rev2]
- *Configuration of PIDC Databases* [IDC5.1.3Rev0.1]
- *IDC Processing of Seismic, Hydroacoustic, and Infrasonic Data* [IDC5.2.1]

- *Configuration of PIDC Processing Data Files* [IDC6.2.4]
- *Distributed Application Control System Software User Manual* [IDC6.5.2Rev0.1]
- *Analyst Review Station Scheme Functions* [IDC7.2.2]

See "References" on page 369 for a list of documents that supplement this document. The following UNIX manual (man) pages apply to the existing Time-series Analysis software:

- *ARS*
- *XfkDisplay*
- *Map*
- *SpectraPlot*
- *PolariPlot*
- *AEQ*
- *IADR*
- *HART*
- *dman*
- *DFX*

USING THIS DOCUMENT

This document is part of the overall documentation architecture for the IDC. It is part of the Technical Instructions category, which provides guidance for installing, operating, and maintaining the IDC systems. This document is organized as follows:

- Chapter 1: Introduction

  This chapter provides an overview of the software's capabilities, development, and operating environment.

- Chapter 2: Operational Procedures

  This chapter describes how to use the software and includes detailed procedures for startup and shutdown, basic and advanced features, security, and maintenance.

- Chapter 3: Troubleshooting

  This chapter describes how to identify and correct common problems related to the software.

- Chapter 4: Installation and Configuration Procedures

  This chapter describes how to install, configure, and validate the software.

- References

  This section lists the sources cited in this document.

- Glossary

  This section defines the terms, abbreviations, and acronyms used in this document.

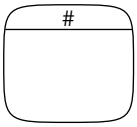
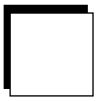
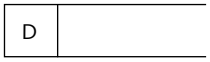
- Index

  This section lists topics and features provided in this document along with page numbers for reference.

Conventions

This document uses a variety of conventions, which are described in the following tables. Table I shows the conventions for data flow diagrams. Table II lists typographical conventions. Table III describes the conventions used in instructions for using the keyboard, commands, and menus.

TABLE I: DATA FLOW SYMBOLS

Description	Symbol[1]
process	
external source or sink of data	
D = disk store Db = database store	
control flow	
data flow	

1. Symbols in this table are based on Gane-Sarson conventions [Gan79].

TABLE II: TYPOGRAPHICAL CONVENTIONS

Element	Font	Example
database table	**bold**	**affiliation**
database account	CAPS	IDCX:**msgdisc**
database attributes	*italics*	*mb_ave*
processes, software units, and libraries		*analyst_log*
user-defined arguments and variables used in parameter (par) files or program command lines		<*action*>`.fp`
titles of documents		*Database Schema*
computer code and output	`courier`	`[info]:Parameter inetd - 1`
filenames, directories, and websites		`ARS.par`
text that should be typed exactly as shown		`ps -fu` <*cds-user-name*>

TABLE III: CONVENTIONS FOR USER INSTRUCTIONS

Instruction	Explanation	Example
choose	Use keyboard shortcuts or click once with your (left) mouse button to select a menu option.	Choose File > Print.
click	Press and release the appropriate mouse button to activate a graphic object on the screen.	Click Done.
display	A general reference to a window or subsection of a window.	Select one or more channels to be sorted to the top of the *ARS* display.
double-click	Click a mouse button twice without moving the pointer.	Double-click the icon to reopen the program.

TABLE III: CONVENTIONS FOR USER INSTRUCTIONS (CONTINUED)

Instruction	Explanation	Example
drag	Hold down the left mouse button while moving the pointer.	Drag the pointer to draw a rectangle around the region of interest.
key-key	Indicates simultaneous key strokes. Hold down the first key and press the second key.	control-e (Hold down the control key and press the letter e.)
menu > submenu	Choose (submenu) from (menu).	File > Print. (Choose Print from the File menu.)
press	Press a key or sequence of keys, or hold down the left mouse button.	Press the enter key.
pull-down, pull-up, or pull-right menu	A list of options related to a menu. The list appears for as long as you press on the related menu.	Choose a year from the Date pull-down menu.
screen, monitor	Hardware display monitor.	The left screen displays the Common Desktop Environment (CDE) menu.
select	Highlight or click on data.	Select the text to be copied. Select a waveform.
toggle	Turn a particular mode on or off by clicking on a button or key.	Use the Line Style toggle button to switch between grid modes.
window	Application's Graphical User Interface (GUI).	The *ARS* window includes an event list.

Chapter 1: Introduction

This chapter provides a general description of the software and includes the following topics:

- Software Overview
- Functionality
- Inventory
- Environment and States of Operation

Chapter 1: Introduction

SOFTWARE OVERVIEW

Figure 1 shows the logical organization of the IDC software. The Interactive Analysis Subsystem is part of the Time-series Analysis CSC, which is one component of the Interactive Processing CSCI. Figure 2 shows the processing flow of the IDC system and the relationship of the Interactive Analysis Subsystem to other components of the system.

The Interactive Analysis Subsystem is comprised of a number of applications that support interactive analysis of time-series data. The central application for interactive analysis is the *Analyst Review Station (ARS)*, which displays seismic, hydroacoustic, and infrasonic (S/H/I) waveform data and derived parameters. Waveform data first undergo signal and event analysis during an automated processing phase. An S/H/I analyst reviews and edits the output of this processing in *ARS* (process 3 in Figure 2). The analyst then refines generated arrivals, events, and location hypotheses and adds new arrivals and events missed during the automated phase. Modifications are saved to an output database. A further stage of automated processing (process 4 in Figure 2) follows analysis, and the output is ready for quality review. Lead analysts and other personnel use the interactive applications during quality review. A bulletin is then published for States' Parties to examine.

Besides *ARS*, a number of associated tools are available for specialized signal analysis and signal feature extraction:

- *XfkDisplay*

  XfkDisplay is the azimuth and slowness determination tool.

- *Map*

  Map provides an interactive graphical display of the geographic aspects of S/H/I data.

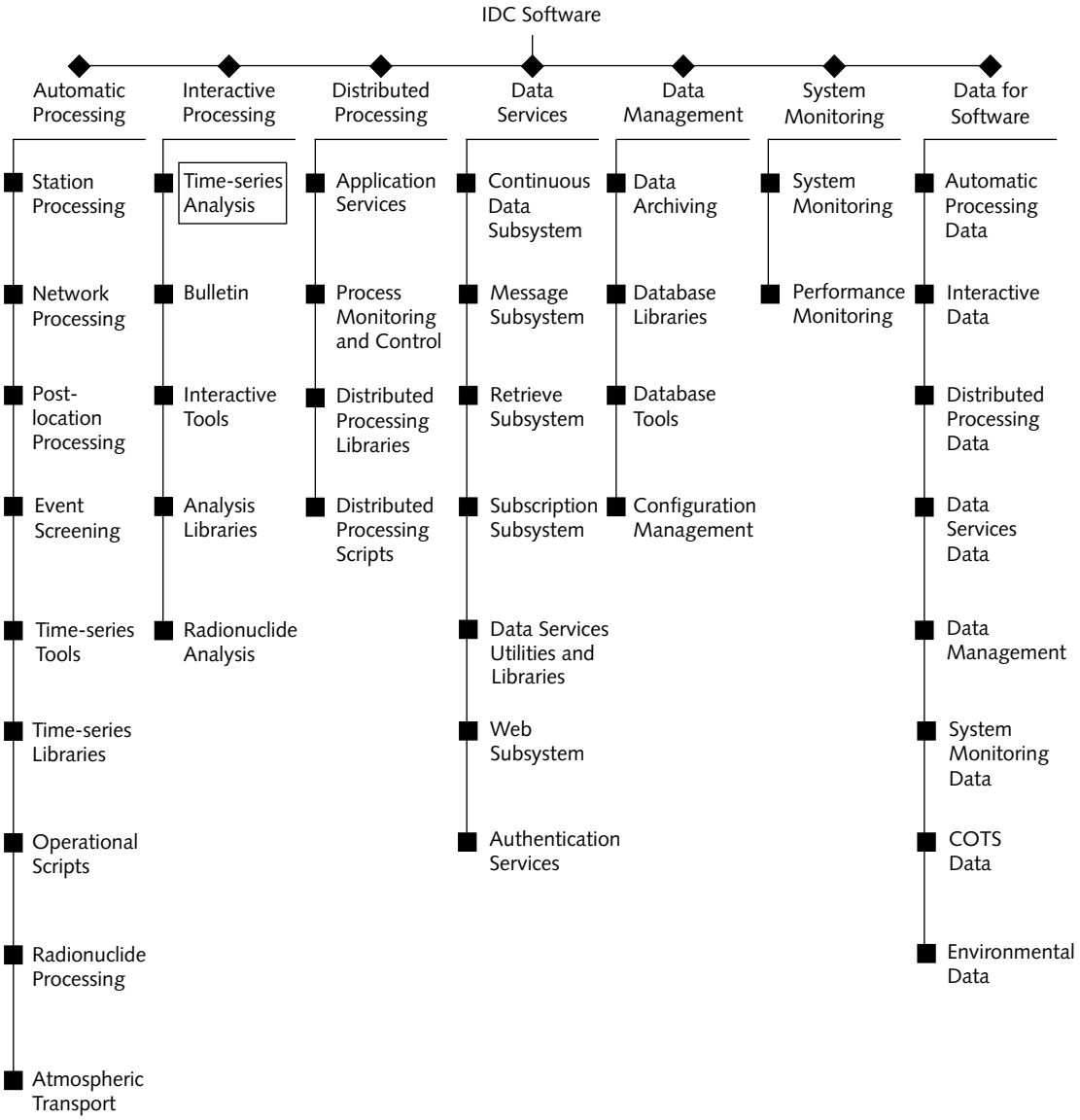


FIGURE 1. IDC SOFTWARE CONFIGURATION HIERARCHY

- *SpectraPlot*

  SpectraPlot provides the power spectrum of a waveform segment.

- *Anomalous Event Qualifier (AEQ)*

  AEQ provides a statistical probability that an event is anomalous, based on historical data.

- *Interactive Auxiliary Data Request Tool (IADR)*

  IADR allows the analyst to request additional waveform data from auxiliary stations.

- *Hydroacoustic Azimuth Review Tool (HART)*

  HART allows for interactive analysis of hydroacoustic azimuths.

- *PolariPlot*

  PolariPlot is a polarization analysis and display tool.

- *Interactive Detection and Feature Extraction (DFX)*

  DFX calculates features such as amplitude and period from seismic or hydroacoustic signals.

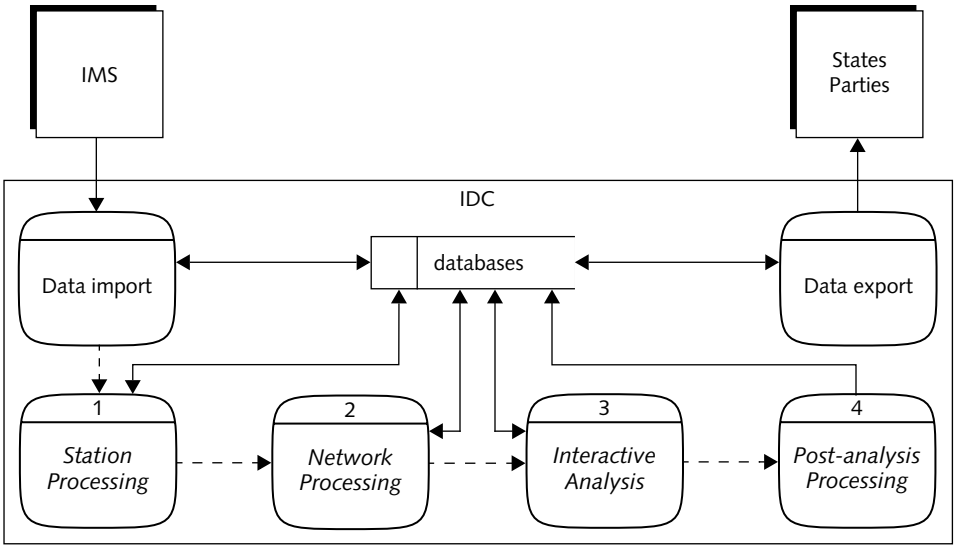


FIGURE 2. IDC PROCESSING FLOW

Figure 3 shows a simplified interactive processing flow model. In this model an analysis session is started through the *analyst_log* application. In *analyst_log*, a time window for analysis is selected and the *ARS* application is started. The time window parameters are written to the `ARS.load` data file in the analyst's home directory. *ARS* reads the `ARS.load` file on startup and uses these parameters to constrain the data it reads and writes to the database. *ARS* communicates with and starts the other interactive applications via messages relayed by *dman* and the interprocess communication system (IPC). IPC messages specify the permanent and temporary database tables used for the transfer of data between interactive applications.

FUNCTIONALITY

The Interactive Analysis Subsystem is designed for analyst review of S/H/I waveform data and automated processing results comprised of events and arrivals. The central component for analysis is the *ARS* application. In *ARS* waveforms are displayed as horizontal time-series traces with arrival times indicated by phase labeled vertical bars. Event lists are displayed above the waveforms with preliminary estimates of location and origin time. The primary role of *ARS* and its associated tools is to allow you to interactively examine arrivals and their attributes as an aid in determining which arrivals should be associated as an event. *ARS* and its tools are also useful for examining and, if necessary, modifying the specific characteristics of individual arrivals and for defining new arrivals or creating new events where these were missed by automated processing. *ARS* interfaces with the database so that interactive modifications can be saved.

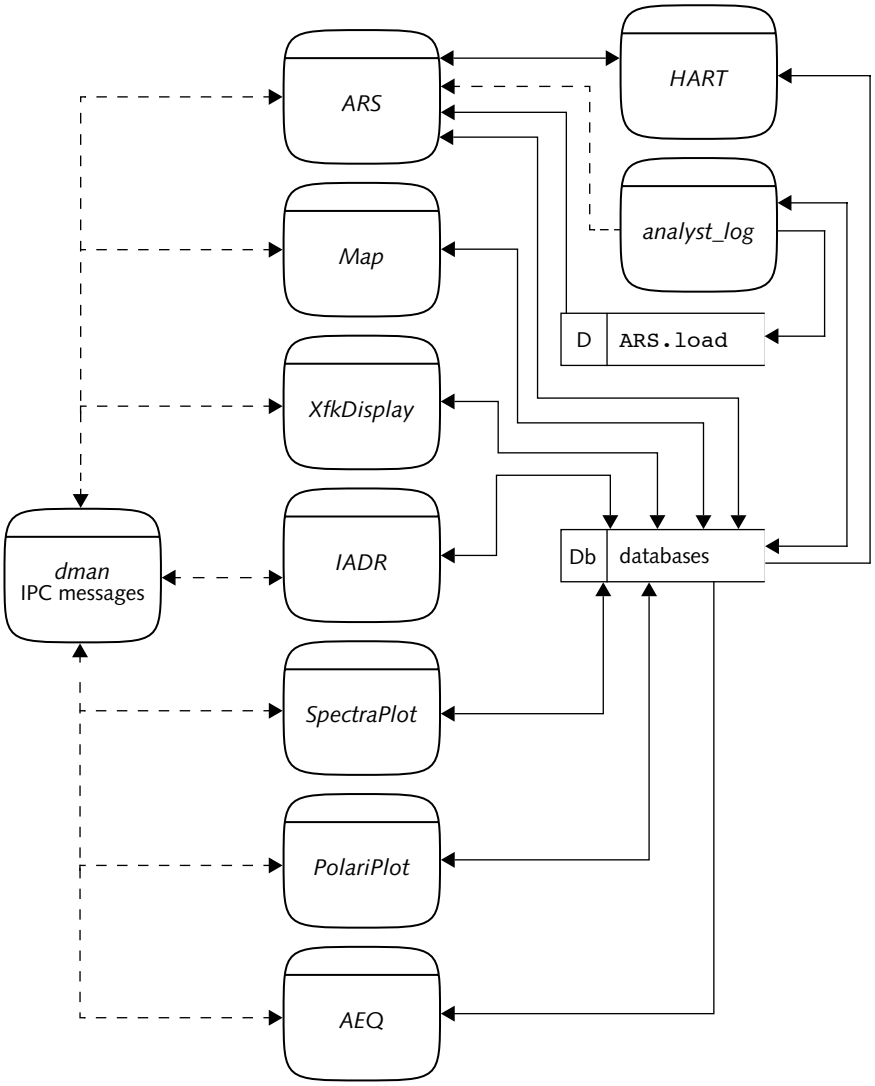


FIGURE 3. INTERACTIVE PROCESSING FLOW

Features and Capabilities

ARS combines the three S/H/I time-series monitoring technologies into one display. This means that multi-technology events can be refined or created in *ARS*. *ARS* provides a wide range of functionality for viewing and analyzing both waveform data and derived parameters. The data presentation in the waveform display can be adjusted by zooming, sorting, filtering, and adding or removing displayed channels. Arrivals can be added, deleted, retimed, compared with theoretical arrival times, and associated or disassociated with events. Through *ARS* you refine, create, or reject events and save these reviewed events to the database for further processing in producing a bulletin.

ARS is supported by a group of analysis tools that perform expanded or specialized analysis. Examples:

- *XfkDisplay* graphically presents an arrival's back-azimuth and slowness (inverse velocity) to aid in evaluating its association to an event.
- *SpectraPlot* performs spectrum analysis on waveform data.
- The *Map* application maps event and station locations enabling analysts to observe where an event occurred and the geographic distribution of stations where arrivals were detected.
- *AEQ* compares event parameters with historical data and reports if the event is statistically anomalous in some way.

Automated processing functions that compute signal features such as amplitude, period, and signal-to-noise ratio (snr) can be recalled during interactive analysis to update hydroacoustic or seismic arrival parameters.

Performance Characteristics

Delays are often observed during initialization of individual applications. *ARS* takes considerable time to load data. Four to eight hours of data are typically loaded into *ARS* for routine analysis. However, *ARS* is capable of loading more than 24 hours of data, and its performance slows as more data are loaded. *XfkDisplay*, *SpectraPlot*,

PolariPlot, and *AEQ* are all initialized when they are first used, but subsequent use elicits rapid response. Interactive recall processing, *IADR*, *HART*, and *DFX* are initialized each time they are invoked; you will observe some latency with these tools.

ARS is typically used to display waveform data from a large number of stations. *ARS* tends to slow briefly when waveform data are manipulated. Larger processing latencies include aligning arrivals, sorting channels, adding additional channels, and beaming (although you can select an option for beaming that runs as a background process). Try to analyze one technology at a time. Because the bulk of events that are built by the automatic system are seismic, seismic data are displayed most of the time. Hydroacoustic waveforms are recorded at a much higher sampling rate than the other technologies. Infrasonic analysis requires that channels from each recording station at a site be displayed. This can slow the responsiveness of the *ARS* display. You may wish to display waveforms from these technologies at the end of an event's analysis and undisplay them when not in use, instead of sorting all three technologies together for each event. *ARS* provides functions to switch focus from one S/H/I technology to the next.

ARS and its tools are robust. A failure (*ARS* crash) is not expected with any frequency. A normal rate of failure might be one *ARS* crash per analyst per week. A rate higher than this should be investigated if the cause is unknown, especially if a pattern emerges.

To protect against data loss in the event of a failure, data from your session are automatically stored in UNIX binary files each time *ARS* interacts with the database (save, discard, undiscard, or unfreeze an event). You can also manually save recovery data at your discretion. *ARS* can be configured to write recovery data either in your home directory or on your workstation's local disk to optimize performance.

INVENTORY

This section lists the files, database tables, and database accounts that comprise the Interactive Analysis Subsystem. The software is one processing component of a larger S/H/I monitoring system; therefore, these items do not exist in isolation and are installed as part of the full monitoring system:

Files[1]

```
$(CMSS)/X11/Map_xgksfonts/*
$(CMSS)/X11/app-defaults/AEQ
$(CMSS)/X11/app-defaults/ARS
$(CMSS)/X11/app-defaults/Map
$(CMSS)/X11/app-defaults/PolariPlot
$(CMSS)/X11/app-defaults/SpectraPlot
$(CMSS)/X11/app-defaults/XfkDisplay
$(CMSS)/bin/AEQ
$(CMSS)/bin/ARS
$(CMSS)/bin/DFX
$(CMSS)/bin/HART
$(CMSS)/bin/IADR
$(CMSS)/bin/Map
$(CMSS)/bin/PolariPlot
$(CMSS)/bin/SpectraPlot
$(CMSS)/bin/WaveExpert
$(CMSS)/bin/XfkDisplay
$(CMSS)/bin/dman
$(CMSS)/bin/exec_popup
$(CMSS)/bin/start_hart_server
$(CMSS)/bin/tuxshell
$(CMSS)/config/app_config/DFX/*.par
$(CMSS)/config/app_config/DFX/*/*.par
$(CMSS)/config/app_config/DFX/scheme/*.scm
$(CMSS)/config/app_config/distributed/dman/dman.par
$(CMSS)/config/app_config/distributed/tuxshell/interactive/tuxshell-
      <queue>.par
$(CMSS)/config/app_config/interactive/AEQ/AEQ.clp
$(CMSS)/config/app_config/interactive/AEQ/AEQ.par
$(CMSS)/config/app_config/interactive/ARS/ARS.par
$(CMSS)/config/app_config/interactive/ARS/IDC.scm
$(CMSS)/config/app_config/interactive/HART/HART.par
$(CMSS)/config/app_config/interactive/IADR/IADR.par
$(CMSS)/config/app_config/interactive/Map/IDC_MAP.scm
$(CMSS)/config/app_config/interactive/Map/Map_Analyst_Tools.scm
$(CMSS)/config/app_config/interactive/Map/Mapconfig.scm
$(CMSS)/config/app_config/interactive/Map/overlay.scm
$(CMSS)/config/app_config/interactive/XfkDisplay/XfkDisplay.par
$(CMSS)/config/app_config/interactive/XfkDisplay/arrays/*.par
$(CMSS)/config/app_config/interactive/XfkDisplay/recipes/*.par
$(CMSS)/config/app_config/interactive/analyst_log/analyst_log.par
$(CMSS)/config/app_config/interactive/analyst_log/analyst_log.ppm
```

1. The shorthand notation `$(CMSS)` is a UNIX environmental parameter that points to the root of the IDC software directory tree. The * symbol is a wildcard reference to all files or directories in that location.

```
$(CMSS)/config/earth_specs/BLK_OSO/*
$(CMSS)/config/earth_specs/MAG/atten/atten*
$(CMSS)/config/earth_specs/MAG/atten/slowamp.P
$(CMSS)/config/earth_specs/MAG/mdf/idc_mdf.defs
$(CMSS)/config/earth_specs/MAG/mdf/idc_mdf.defs
$(CMSS)/config/earth_specs/MAG/tlsf/idc_tlsf.defs
$(CMSS)/config/earth_specs/MAG/tlsf/idc_tlsf.defs
$(CMSS)/config/earth_specs/SASC/sasc*
$(CMSS)/config/earth_specs/TT/vmsf/ars.defs
$(CMSS)/config/earth_specs/TT/vmsf/ims.defs
$(CMSS)/config/station_specs/*.par
$(CMSS)/config/system_specs/DFX.par
$(CMSS)/config/system_specs/app-resources/ARS
$(CMSS)/config/system_specs/app-resources/Map
$(CMSS)/config/system_specs/app-resources/SpectraPlot
$(CMSS)/config/system_specs/app-resources/XfkDisplay
$(CMSS)/config/system_specs/automatic.par
$(CMSS)/config/system_specs/env/analyst.dt/*
$(CMSS)/config/system_specs/env/default.*
$(CMSS)/config/system_specs/env/global.env
$(CMSS)/config/system_specs/env/process.dt/icons/*
$(CMSS)/config/system_specs/env/terminfo/*
$(CMSS)/config/system_specs/interactive.par
$(CMSS)/config/system_specs/process.par
$(CMSS)/config/system_specs/shared.par
$(CMSS)/contrib/bin/mon_dd
$(CMSS)/contrib/bin/qcmap
$(CMSS)/jlib/HART.jar
$(CMSS)/jlib/IADR.jar
$(CMSS)/jlib/ipc.jar
$(CMSS)/jlib/libHART_compute.so
$(CMSS)/jlib/libjipc.so
$(CMSS)/jlib/util.jar
$(CMSS)/scheme/ARSdefault.scm
$(CMSS)/scheme/Mapdefault.scm
$(CMSS)/scheme/Mapgc.scm
$(CMSS)/scheme/general.scm
$(CMSS)/scheme/intrinsic.scm
$(CMSS)/scheme/libpar.scm
$(CMSS)/scheme/math.scm
$(CMSS)/scheme/siod.scm
$(CMSS)/scripts/bin/ARSscan
$(CMSS)/scripts/bin/analyst_log
$(CMSS)/scripts/bin/capture_dt.pl
$(CMSS)/scripts/bin/cleanMStables
$(CMSS)/scripts/bin/crInteractive
$(CMSS)/scripts/bin/mkCMSuserq
$(CMSS)/scripts/bin/rebqc
$(CMSS)/scripts/bin/start
```

$(CMSS)/scripts/bin/today
$(CMSS)config/app_config/automatic/WaveExpert/WaveExpert-IADR-Assess.par
$(CMSS)config/app_config/automatic/WaveExpert/WaveExpert-IADR-Request.par
$(CMSS)config/app_config/automatic/WaveExpert/WaveExpert.par
$(CMSS)config/app_config/automatic/WaveExpert/distance_rule.clp
$(CMSS)config/app_config/automatic/WaveExpert/we_init.clp
$(LOGDIR)/%jdate/interactive/<*role*>-<*host machine*>-<*pid*>
$(LOGDIR)/%jdate/interactive/dman-$(host)-$(USER)-$(agent)
$(LOGDIR)/%jdate/interactive/tuxshell-<*role*>-<*host machine*>-<*pid*>
$(LOGDIR)/HART/<*machine*>_hart.log
$(LOGDIR)/WaveExpert/<*role*>.log
$(TUXDIR)/bin/BBL
$(TUXDIR)/bin/TMQFORWARD
$(TUXDIR)/bin/TMQUEUE
$(TUXDIR)/bin/TMS/TMS_QM
$(TUXDIR)/bin/TMSYSEVT
$(TUXDIR)/bin/TMUSREVT
$(TUXDIR)/bin/tmboot
$(TUXDIR)/bin/tmshutdown
$(TUXDIR)/config/scripts/templates/ubb.analysis_template
/var/tuxedo/PIDC70_analysis/TLOGS/tlog
/var/tuxedo/PIDC70_analysis/ULOGS/ULOG<*jday*>
/var/tuxedo/PIDC70_analysis/config/tuxconfig
/var/tuxedo/PIDC70_analysis/config/ubb
~/.ARSinit
~/.Mapinit
~/.Xdefaults
~/.cshrc
~/.dt/*
~/.login
~/ARS.history
~/ARS.load

Database Tables

affiliation	**allocate_hour**	**amp3c**
ampdescript	**amplitude**	**apma**
arrival	**assoc**	**colordisc**
detection	**discard**	**dseisgrid**
dseisindex	**event**	**event_control**
hydro_arr_group	**hydro_assoc**	**hydro_features**
instrument	**interval**	**lastid**
mapcolor	**mapdisc**	**mapover**
mappoint	**msgdisc**	**na_value**
netmag	**origerr**	**origin**
overlaydisc	**parrival**	**remark**
request	**seisgrid**	**seisindex**
sensor	**site**	**siteaux**
sitechan	**stamag**	**timestamp**
wfdisc	**wftag**	

Database Accounts

STATIC
SEL3
IDCX
LEB
MAP

Temporary Database Tables

ims$_ARS_wfdisc_<*tmp id*>
ims$_ARS_arrival_<*tmp id*>
ims$_ARS_amplitude_<*tmp id*>
ims$_ARS_apma_<*tmp id*>
ims$_ARS_in_origin_<*tmp id*>
ims$_ARS_out_origin_<*tmp id*>
ims$_ARS_in_origerr_<*tmp id*>
ims$_ARS_out_origerr_<*tmp id*>
ims$_ARS_in_assoc_<*tmp id*>
ims$_ARS_out_assoc_<*tmp id*>
ims$_ARS_arrival_<*tmp id*>
ims$_ARS_amplitude_<*tmp id*>
ims$_ARS_apma_<*tmp id*>
ims$_ARS_amp3c_<*tmp id*>
ims$_ARS_detection_<*tmp id*>
ims$_ARS_wfdisc_<*tmp id*>
ims$_ARS_wftag_<*tmp id*>
ims$_ARS_assoc_<*tmp id*>
ims$_ARS_hydro_features_<*tmp id*>
ims$_ARS_arrival_<*tmp id*>
ims$_ARS_assoc_<*tmp id*>
ims$_ARS_origin_<*tmp id*>
ims$_ARS_origerr_<*tmp id*>
ims$_ARS_wftag_<*tmp id*>

ENVIRONMENT AND STATES OF OPERATION

Software Environment

The software is configured to run under Solaris 7 (Sun Microsystem's version of UNIX), CDE 1.3.2, and X11R6.4 and Motif 2.1 windowing libraries. The software depends on the ORACLE 8i database server and the Tuxedo version 6.5 interprocess communication software.

Hardware Environment

You must select the hardware on which to run the software components. Software components are generally mapped to hardware to be roughly consistent with the software configuration model. A typical analyst workstation is a Sun Microsystems Ultra60 computer with dual CPU, 512 megabytes of Random Access Memory (RAM) and dual Creator 3D 24-bit color graphics boards driving dual 21" display monitors. Less powerful hardware configurations of Sun Microsystem's workstations will run the software, but with degraded performance.

Normal Operational State

The Interactive Analysis Subsystem components are used interactively by operators trained in the analysis of S/H/I technology sources. Analysis sessions are initiated by analyst action using a custom configured Sun CDE windowing interface. Individual modules are launched in response to interprocess communication actions using the Tuxedo interprocess communication libraries and initialized using ORACLE database tables, configuration parameter files, and X window resource configuration files. Post interactive analysis recall processing is initiated via database triggers configured into the ORACLE database and activated by analyst actions in the *analyst_log* application.

Contingencies/Alternate States of Operation

The software requires a trained operator and is not intended for use in automated or offline mode. In normal operation the software takes its input from the Standard Event List 3 (SEL3) and saves its output to the Late Event Bulletin (LEB) ORACLE database accounts. *ARS* and its associated tools can be configured to run using database accounts other than these (for example, for training or research purposes). Individual applications can be launched from the UNIX command line if proper command line parameters are provided. UNIX manual (man) pages for each application are available to document command line usage.

Chapter 2: Operational Procedures

This chapter provides instructions for using the software and includes the following topics:

- Software Startup
- Software Shutdown
- Basic Procedures
- Analyst Review Station (ARS) Procedures
- XfkDisplay Procedures
- Map Procedures
- Anomalous Event Qualifier (AEQ) Procedures
- Interactive Auxiliary Data Request (IADR) Procedures
- Hydroacoustic Azimuth Review Tool (HART) Procedures
- PolariPlot Procedures
- SpectraPlot Procedures
- dman Procedures
- analyst_log Procedures
- Advanced Procedures
- Maintenance
- Security

Chapter 2: Operational Procedures

SOFTWARE STARTUP

The Interactive Analysis Subsystem is comprised of a number of programs for interactive analysis of time-series data. The central component of the software is *ARS*, which displays S/H/I waveform data. Additional tools are provided to perform specialized analysis. In general, no single application is launched to run independently of the others, and when used in conjunction the components provide complete information about an arrival or an event. In normal usage, analysis is performed in the main *ARS* display. When you require more specific detail about an arrival, groups of arrivals, or an event, *ARS* sends messages to specific tools to handle the specialized analysis. In response to these messages, the tool is launched to immediately receive and respond to the message and return results to *ARS* as required.

Typically an analysis session begins with *analyst_log*. You use the *analyst_log* application to allocate a time period for analysis, to specify the appropriate data for loading into *ARS*, to launch *ARS*, and to trigger certain post-analysis processes. Detailed procedures for *analyst_log*, *ARS*, and the other applications are provided in subsequent sections. The UNIX operating system automatically displays the CDE menu bar when you log onto your workstation. To conveniently launch *analyst_log* (and start the analysis session) the CDE menu bar at the bottom of the screen has been customized to include the Start Analyst Review menu button as shown in Figure 4.

FIGURE 4. CDE MENU BAR SHOWING START ANALYST REVIEW

In Figure 4, the tab on the CDE toolbar above the Start Analyst Review button provides access to a pull-up menu, which provides additional customized options. This menu provides options to independently start the *dman*, *HART, ARS,* and *analyst_log* applications. These menu options are provided as a convenience for special situations such as starting *ARS* independently of the rest of the Interactive Analysis Subsystem suite. However, the preferred approach for starting the software during normal operations is with the Start Analyst Review button (as described below).

Starting Regular Analysis

To start an analysis session:

1. Log on to your computer workstation. In the login window on your main display monitor, enter your user name, then press the Return key.[1]

   You are prompted to enter your password.

2. Enter your password, then press the Return key. Your key strokes are not echoed (displayed).

   After accepting your password both computer screens initialize. This takes a few moments. The display shows an hour glass symbol while initialization is in progress.

1. The login window offers a command line or login window in addition to CDE. Make sure you use the CDE login.

3. After initialization, the CDE toolbar is located at the bottom of both display screens. The fourth icon button from the left is the Start Analyst Review button shown here. Click this button to start *analyst_log*.

   The *analyst_log* application is displayed on your right screen.

4. In *analyst_log* (and referring to the "analyst_log Procedures" on page 312) choose the Allocation option, and select a time period for analysis. Next, run the *ARSscan* option to update the `ARS.load` file.

5. When this process is complete, click the large *ARS* graphic (shown here) at the bottom middle of the Allocation window in *analyst_log*.

   Three programs are initiated. The *dman* and *ARS* programs are launched, and their application windows appear on the left screen. *WEAssess* is also initiated (see "Interactive Auxiliary Data Request (IADR) Procedures" on page 248).

   An *ARS* window appears with only the toolbar and menu displayed. No waveform data are displayed upon initial launch. The initial *ARS* window is shown in Figure 5.

6. To load data, choose File > Read.

   The date and time that were selected in *analyst_log* appear in a dialogue box, as shown in Figure 6. The operational database and network are also specified.

7. After checking the information, click Done in the dialogue box.

   ARS begins the process of loading the waveform data for that time period, along with automatically processed arrivals and events.

You can now begin processing the data, using the procedures described in the subsequent sections.

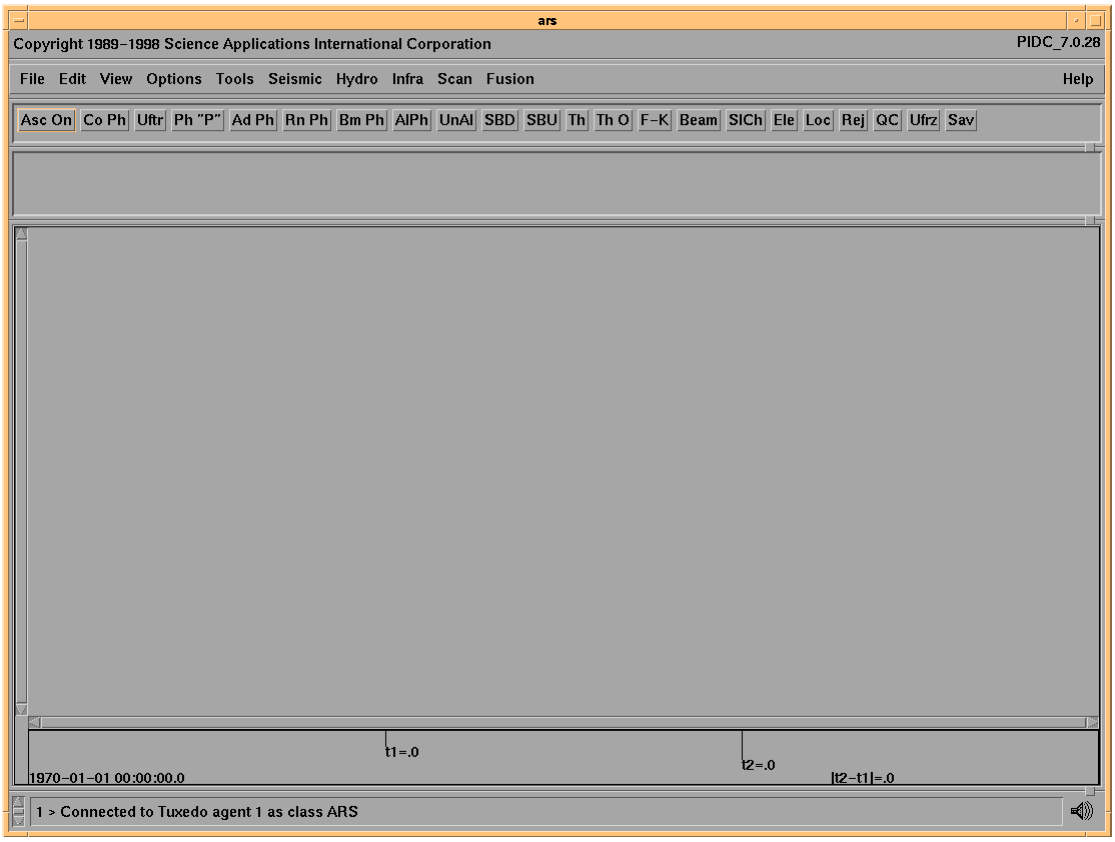

ars
Copyright 1989–1998 Science Applications International Corporation
PIDC_7.0.28
File Edit View Options Tools Seismic Hydro Infra Scan Fusion
Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav
t1=.0
t2=.0
1970-01-01 00:00:00.0
|t2-t1|=.0
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 5. ARS MAIN WINDOW AT STARTUP

Startup Notes

Loading data into *ARS* can take several minutes. The waveform display partially refreshes during the load process. After the display is complete and the hour-glass cursor has been replaced by a pointer cursor you can begin interacting with the data. In the initial waveform display *ARS* shows the entire loaded time window, normally four hours. At this time scale, waveforms are shown only as straight lines where data are present. You will need to zoom in to see actual waveforms.

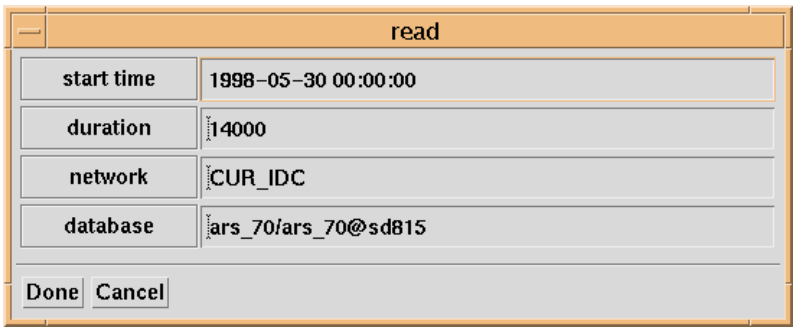


FIGURE 6. ARS READ WINDOW

When started, *ARS* displays the status of the Tuxedo interprocess communication system, which *ARS* uses for communicating with the other analysis tools. If Tuxedo is running, *ARS* reports this with the message shown in Figure 7.

FIGURE 7. ARS IPC STATUS MESSAGE

By default, the first session is run as Tuxedo agent 1. All applications launched as part of this session then communicate with *ARS* using Tuxedo agent 1. If a second *ARS* session is launched while the first session is still running, it is connected to Tuxedo through agent 2. All tools launched through this second session communicate using agent 2. Put simply, agents can be considered as communication channels through which tools belonging to the same session communicate. Tuxedo agents ensure that the correct tool communicates with the correct *ARS*. If Tuxedo is not available or has been disabled, *ARS* is unable to communicate with any of its associated tools. If *ARS* reports that it is unable to initiate interprocess communications, contact your system administrator.

SOFTWARE SHUTDOWN

You normally exit an analysis session either by choosing File > Exit in *ARS* or by using the Kill All option in *dman*.

To exit *ARS* through the File menu:

1. In *ARS*, choose File > Exit.

   A confirmation dialogue box appears. If unsaved changes exist in the *ARS* session, the dialogue box indicates that changes will be discarded.

2. To continue to exit, click OK.

To exit *ARS* and all tools related to the *ARS* agent from *dman*:

1. Select Kill All in *dman*.

   dman presents a confirmation dialogue box.

2. Click OK to send an exit signal to all running applications using the same Tuxedo agent.

   The tools exit without presenting additional dialogue box prompts.

Exit all Interactive Analysis Subsystem applications before you use the EXIT button on the CDE tool bar to log out of your UNIX session.

BASIC PROCEDURES

Session Display Organization

The typical analyst workstation uses two screens to display *ARS* and its associated tools. Generally, the *ARS* session is displayed on the left screen (0.0 screen), while the other tools are displayed on the right screen (0.1 screen). The left screen shown in Figure 8 contains the CDE toolbar at the bottom, the *ARS* main window, and the *dman* window. You may also display and use a mail tool, text editor, or interactive shell window during an analysis session. Examples of these are shown in Figure 8, iconified or in a closed-window state.

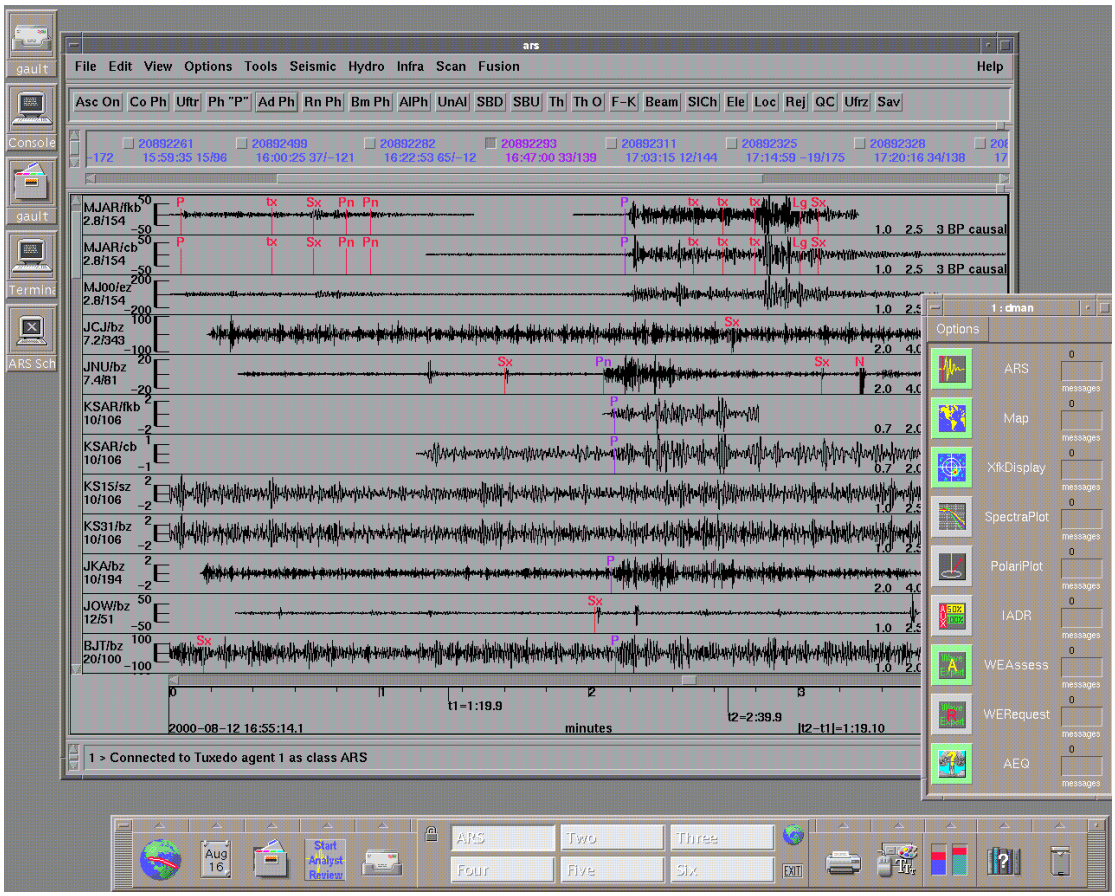


FIGURE 8. LEFT SCREEN DURING ANALYSIS SESSION

Figure 9 shows a typical right screen display. The *analyst_log*, *ARS* filter window, *AEQ*, *XfkDisplay*, and *Map* are shown. Tools such as *IADR*, *HART*, *SpectraPlot*, and *PolariPlot* are configured to display on this screen as well. To reduce clutter, you may choose to iconify or undisplay these tools while they are not in use. *WEAssess* is also launched to display on the right screen, but is generally kept iconified (see "Interactive Auxiliary Data Request (IADR) Procedures" on page 248).

Figures 8 and 9 show the default display configuration. You may prefer a different display for your analysis session. "Chapter 4: Installation and Configuration Procedures" on page 337 provides further information about changing this configuration.

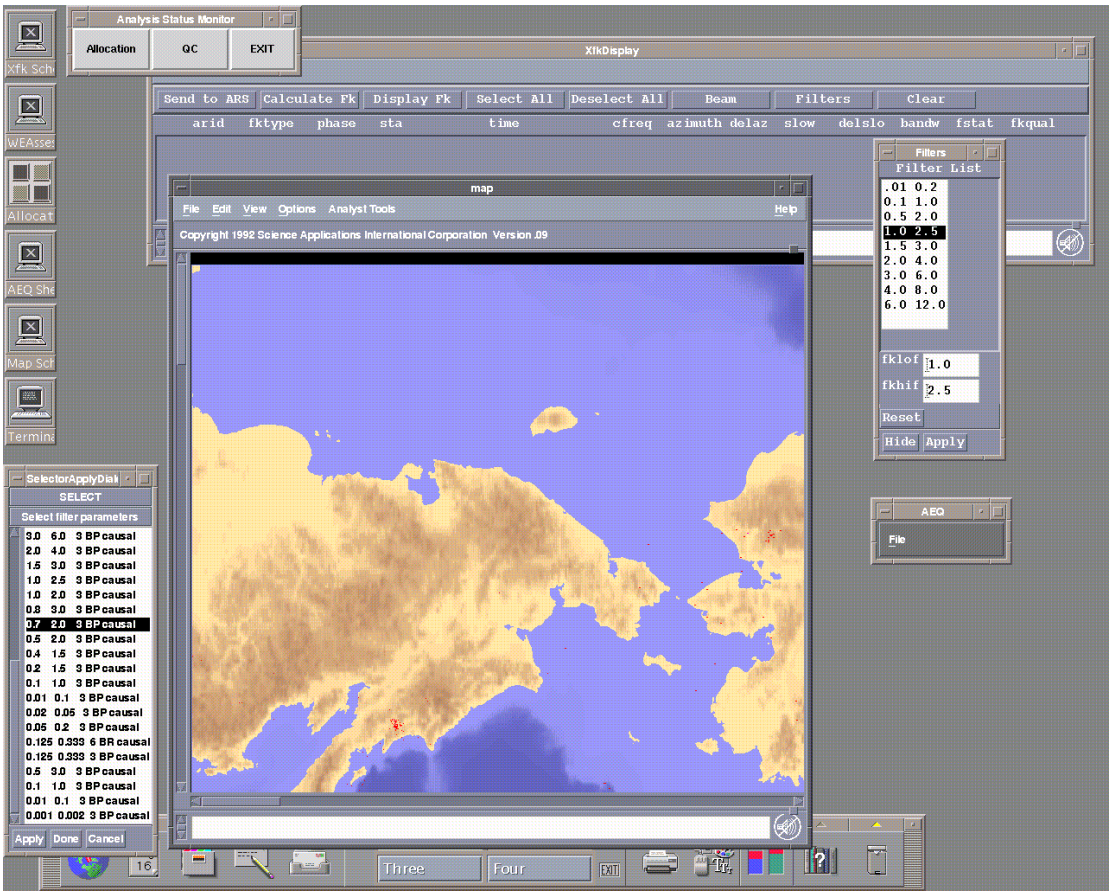


FIGURE 9. RIGHT SCREEN DURING ANALYSIS SESSION

Using Menus

ARS and the other applications each contain a menu bar across the top of their window. This menu bar contains one or more pull-down menus. A pull-down (or pull-up, pull-right) menu expands to show a list of options related to the menu. There are two methods to open a main menu. For the first method, click once on the menu name with the left mouse button to reveal the menu and submenu options. Then click the left mouse button on the menu or submenu option to select it. The options remain open. For the second method, click on the main menu, and drag the mouse to the desired option or submenu, then release the button. The submenus are highlighted and open one by one when you drag the mouse over them. Using this method, the menu options close on release. The click-drag-release method can be used however deeply the submenus are nested. To select the desired menu option, drag the mouse through the submenus until the desired option is highlighted, then release the mouse. This activates the function.

In addition to menus, *ARS* and several other applications provide toolbars with labeled buttons, which provide quick access to commonly used functions. To activate a function from the toolbar, click on the toolbar button once using your left mouse button.

Using Common Mouse Actions

Several mouse button actions are commonly used in the Interactive Analysis Subsystem applications. Often you will need to select an object such as an arrival or channel in *ARS* or a station location in *Map*. To select an object, position the mouse pointer over the object, and click on the object once using your left mouse button. When objects are selected they become highlighted.

Another common action is double-clicking. This involves clicking the left mouse button twice in quick succession without moving the pointer. For example, the *ARS* Filter Selection window presents a list of filter options. Double-clicking a filter option both selects and applies the filter in one operation.

A drag action requires that you press the left mouse button while moving the pointer (a click-drag-release operation). Drag actions were used in the previous section to select submenu items in one step. Another example is to use the drag action to move an object, such as in manually resizing a display window. This is done by moving the cursor to the corner of the window, clicking on the corner object, and dragging the corner to a new location, making the window larger or smaller. Release the mouse when the desired size is set.

Often the data presented in a display are too large to fit completely in the available window size. Scroll bars allow you to control which portion of the data to display in the window. Scroll bars are vertical/horizontal depending on the nature of the displayed data. To scroll, click or drag in various portions of the scroll bar.

Scheme and Shell Windows

A number of applications provide a Scheme or shell window in addition to their graphical window. These are text windows that display additional status and error messages. They start in an iconified or minimized state to take up as little screen area as possible. You can double-click on them to open them. Those applications that provide a Scheme interface, notably *ARS* and *Map*, are able to interpret Scheme commands in the shell window. An introduction to *ARS Scheme* is provided in [IDC7.2.2].

Obtaining Help

In addition to the IDC documentation listed in "References" on page 369, man pages provide useful sources for additional information on the applications. Man pages are available for *ARS*, *AEQ*, *analyst_log, dman, HART*, *IADR*, *Map*, *PolariPlot*, *SpectraPlot*, and *XfkDisplay*. Often a Help button is provided in an application's menu bar; this button usually provides a brief description for functions within that window.

When you hover the cursor over a menu option or toolbar button in *ARS*, a quick-tip appears. Quick-tips provide more complete function names than are provided in the cryptic menu or button label (see "Quick-tips" on page 37).

ANALYST REVIEW STATION (ARS) PROCEDURES

ARS Window Layout and Organization

The main *ARS* window is the central focus for time-series analysis. Within its borders events are reviewed or built, and access to the majority of the Interactive Analysis Subsystem's functionality is provided. The *ARS* main window shown in Figure 10 is a busy display, rich in information.

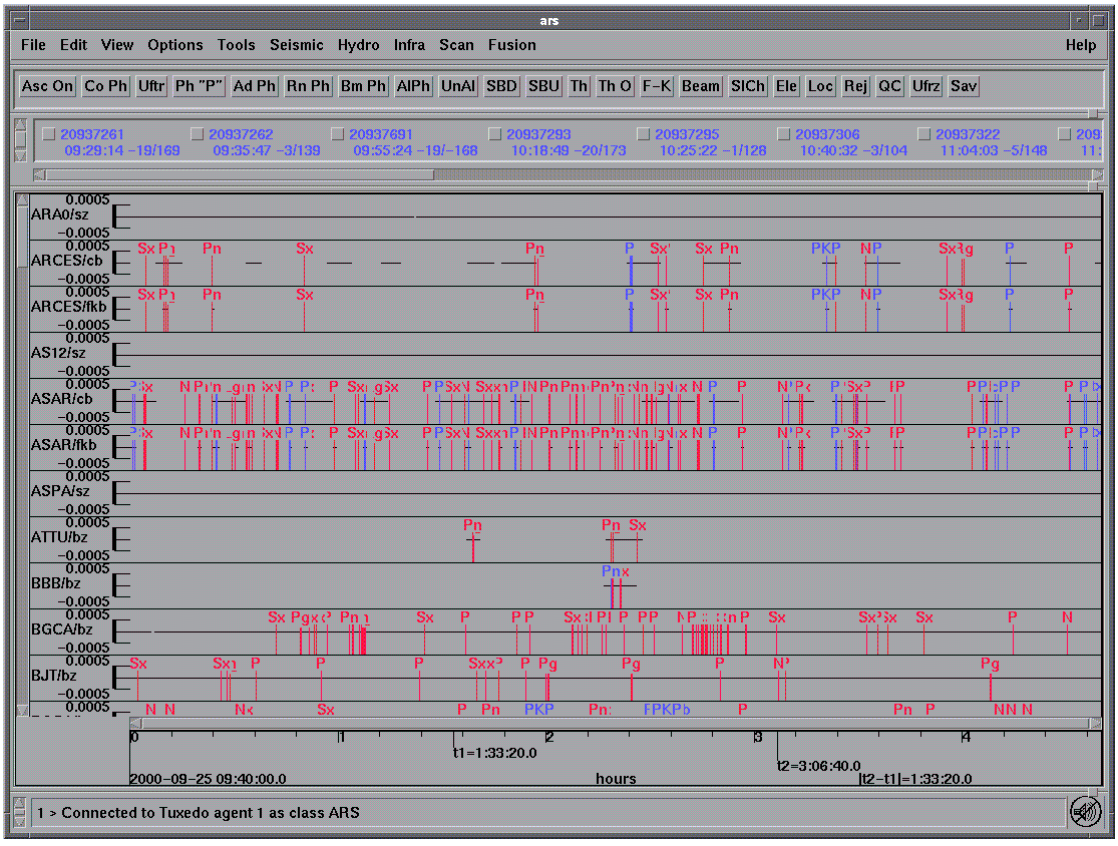


FIGURE 10. MAIN ARS WINDOW

This window displays the following items:

- Functions
- Events
- Waveforms
- Waveform Labels
- Amplitude Scaling and Measurement
- Deselecting All Objects
- Time Bar
- Message Area
- Resizing Areas in the ARS Window
- Quick-tips
- Popup Menus

Functions

The top section of the *ARS* main window contains pull-down menus and toolbar buttons, as shown in Figure 11. A Help function at the top right provides a limited description of the available functionality. The toolbar buttons provide shortcuts to functions commonly used during an analysis session. Each menu option and button is described individually in "Toolbar Button Functions" on page 41 and "ARS Menus" on page 68.

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav

FIGURE 11. ARS MENUS AND TOOLBAR BUTTONS

Events

The event scrolling list is located below the *ARS* toolbar (Figure 12). The list displays all events built by the Automatic Processing software and any events that you create during analysis. Each event is identified by the event identification number (*evid*), the time of the event, and the latitude/longitude of the event.

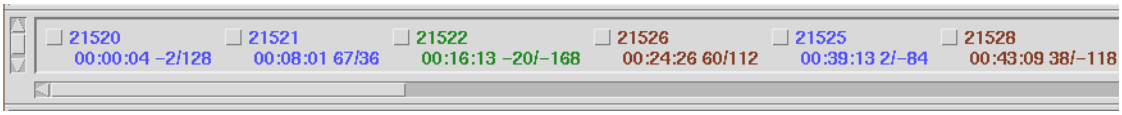


FIGURE 12. ARS EVENT LIST

Quick-tips on the event objects (see "Quick-tips" on page 37) display the origin identification number (*orid*). The terms event and origin are often used synonymously, even in *ARS* menus. Generally, analysts refine events to determine the most accurate origin. In the course of event refinement, several different origins may be computed. This document will use the term event to refer to the objects that analysts work with and will use the term origin to refer to the result of an event's location computation.

To select an event, click the square box beside the event. To select additional events, press the shift key while clicking the additional events. If you select an event without pressing the shift key, all other events are unselected. To view additional events, use the scroll bar below the list to scroll left or right through all events in the time window.

Events are labeled in different colors, depending on their status. Table 1 explains the color scheme.

TABLE 1: EVENT COLORS

Event Color	Explanation
blue	The event has not been modified since it was last located.
purple	The event has been modified; one or more associated arrivals have been modified. Locating the event will return it to blue.
red/orange	An arrival originally associated to this event has been reassociated to another event.
green	The event has been saved.
brown	The event has been discarded.

Waveforms

The waveform display is located below the event list. This display contains horizontally and vertically scrolling traces of the waveform data for each channel. Channels are arrayed vertically, and the horizontal axis represents time. Labeled arrival bars are superimposed on the waveform traces. These labeled arrival bars show the time and phase type for each channel's arrivals visible in the current time window. A typical waveform display for one channel is shown in Figure 13. To the left of the waveform trace is a waveform label containing the channel name and amplitude scale. These components are discussed further in the next section. The applied filter, if present, is displayed at the far right of the waveform (see "View > Filter" on page 106). Scroll bars to the left of and below the waveform display allow you to move vertically through the available channels or back and forth in time through the available arrivals.

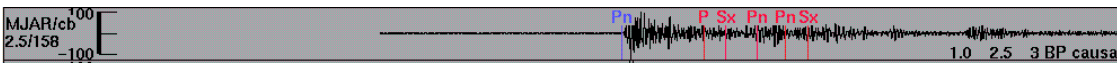


FIGURE 13. ONE CHANNEL WAVEFORM TRACE

ARS was designed to display waveforms from all three time-series technologies, seismic, hydroacoustic, and infrasonic, to allow for an integrated analysis of each event. The travel times for signal energy differ depending on technology (that is, on the medium through which it propagates), with seismic waves traveling the fastest, hydroacoustic waves traveling somewhat slower, and infrasonic waves traveling considerably slower still. In addition to the waveform time window, which you initially specified, *ARS* loads an additional 20 minutes of seismic data, an additional 1.5 hours of hydroacoustic data, and an additional 5 hours of infrasonic data. This additional data allows the energy from events occurring near the end of the time window to reach more distant stations and still be viewable in the *ARS* waveform display.

Waveform Labels

Waveform labels are displayed to the left of their associated waveforms. A number of different channel types may be displayed: vertical components, horizontal components, or beamed channels. The name of the channel is the combination of the abbreviation of the station name and the abbreviation of the channel component. For example, in Figure 13 the channel name is MJAR/cb representing the coherent beam channel at station MJAR (Matsushiro, Japan).

The great-circle distance from the station to the event location (in degrees) is displayed beneath the channel name. The station-to-event azimuth (in degrees) from north is displayed to the right, separated by a slash.

Amplitude Scaling and Measurement

A waveform amplitude scale bar is located between the waveform trace and the channel name. This bar looks like a capital letter E. Waveforms are displayed as demeaned digital instrument counts. By default the waveform is auto-scaled so that the maximum amplitude within the display window fits into the channel's available display area. The two numbers at the top and bottom of the scale bar are the waveform vertical scale and the waveform offset. By clicking and dragging the middle mouse button over the waveform vertical scale (top number), the wave-

form's height is scaled larger or smaller. Waveform data are clipped if they extend outside the channel's display area. Figures 14 and 15 show example waveforms before and after height adjustment.

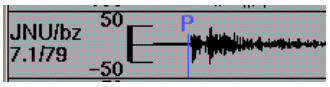


FIGURE 14. WAVEFORM BEFORE HEIGHT ADJUSTMENT

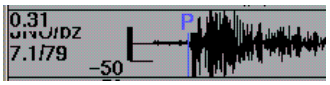


FIGURE 15. WAVEFORM AFTER HEIGHT ADJUSTMENT

By clicking the middle mouse button over the bottom number, the scaling jumps by a factor of 10. This adjustment is often too coarse for practical use. Click and move the right mouse button over the scale bar to adjust the waveform offset; this method moves the waveform up and down in the waveform display without changing its amplitude scaling, as shown in Figure 16. Scrolling or zooming resets to auto-scaling.

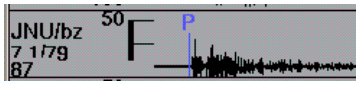


FIGURE 16. WAVEFORM AFTER OFFSET ADJUSTMENT

Using mouse actions within the waveform trace you can display demeaned waveform counts or obtain a calibrated measure of period and amplitude. Right click where desired in the waveform display to show the time and relative amplitude at

that time as shown in Figure 17. Because amplitude counts are demeaned and possibly filtered, they appear as positive or negative floating point numbers (for example, the –0.8 value shown in Figure 17).

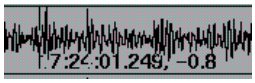


FIGURE 17. VIEW SELECTED TIME AND AMPLITUDE COUNTS

Period and amplitude are measured based on a selected arrival.

To measure the period and amplitude:

1. Select an arrival by left clicking on the arrival label. The arrival label is surrounded with an open box when the cursor is in the selection area and with a closed box when selected.
2. Using the right mouse button, select a maximum or minimum within a few seconds after the selected arrival time.

   Time and counts are displayed, as shown in Figure 17.
3. Using the right mouse button, select a maximum or minimum on the waveform one full period later.

   The half-period and calibrated amplitude (in nanometers) is computed and displayed, as shown in Figure 18.

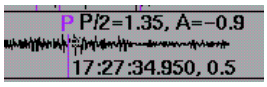


FIGURE 18. VIEW PERIOD/2 AND CORRESPONDING AMPLITUDE

Deselecting All Objects

You can deselect all channels and arrivals by clicking once with the left mouse button anywhere in the waveform display except on a channel name or phase label; that is, click any place in the waveform display that will not select an object. This action deselects all currently selected channels and arrivals in the waveform display. Selected events remain selected.

Time Bar

The time bar is located beneath the horizontal scroll bar for the waveform display, as shown in Figure 19. This part of the *ARS* window presents the time scale for the currently displayed waveforms and varies depending on the originally loaded time window, the current zoom level, and the position of the horizontal scroll bar. The time scale units are displayed at the bottom of the time bar. Time scaling is delineated in units of 1/10 seconds, seconds, minutes, hours, or days. The date and time of the left edge of the viewed time window is displayed at the bottom left of the time bar.

FIGURE 19. TIME BAR IN ARS

Two dynamic time scale markers labeled *t1* and *t2* are displayed on the time scale. Each marker is labeled with its current offset on the time scale. The absolute time difference between the two markers, labeled |*t2-t1*|, is displayed at the bottom of the time bar. Use mouse drag actions to move the markers horizontally on the time scale. Use *t1* when adjusting an existing arrival's time or to mark a time to add a new arrival (see "Edit > Retime" on page 82 and "Edit > Add Arrival..." on page 86). Use *t1* and *t2* to mark a subset of the current display for zooming in or magnifying the waveform view.

To zoom:

1. Click on the *t1* bar with the left mouse button. Press the mouse button while dragging it along the bottom of the screen in a horizontal motion to the desired time.

   A vertical line appears. This line runs up through the entire *ARS* waveform display and moves with the dragging motion. This line helps you track where the *t1* bar is relative to the data.

2. When you are satisfied with the position of the *t1* bar, release the mouse button.
3. Perform the same actions with the *t2* bar.
4. Select the zoom function (use control-z or choose Edit > Zoom).

   The waveform display zooms to the time window defined by *t1* and *t2*.

To determine the time difference between two arrivals:

1. Click the *t1* bar with the left mouse button. Press the mouse button while dragging horizontally along the bottom of the screen until the vertical line that extends up through the *ARS* window overlaps with the desired arrival time. Release the mouse button.
2. Perform the same action with the *t2* bar for the second arrival.

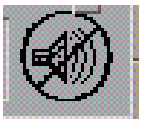
   The |*t2*–*t1*| output in the time window displays the absolute time difference between the two arrivals.

Message Area

When *ARS* has performed an action requiring explanation or if an error or warning must be issued to the analyst, a message is displayed at the bottom of the *ARS* screen. Figure 20 shows an example of such a message. In this example the analyst has attempted to retime an arrival more than 4 seconds from its original location. This action breaks a rule programmed into *ARS* so an error message is sent to the window (see "Edit > Retime" on page 82 in the Edit menu). As each message is

sent to the window, *ARS* scrolls the message area to display the most recent message. A small scroll bar to the left of the message area allows you to see previous messages.

FIGURE 20. MESSAGE AREA IN ARS



An alarm bell indicator is located at the right of the message area. By default *ARS* launches with the alarm bell turned on. The bell sounds when *ARS* reports a message. To turn the bell off, select it using the left mouse button. A line will appear drawn through the bell indicating that the sound has been turned off.

Resizing Areas in the ARS Window

In the complete *ARS* window shown in Figure 10 on page 28, the menu and toolbar, event list, waveform/time bar, and message areas are separated by horizontal lines with a square tab toward their right ends. You can resize these areas within the *ARS* window by using the left mouse button to drag the tabs up or down. Dragging the line above the message area allows you to view more error messages, but sacrifices the size of the waveform area in the process.

Quick-tips

Other interactive features of the *ARS* window are quick-tips and popup menus. This section describes quick-tips; popup menus are described in the next section. Quick-tips are descriptions of *ARS* functions and objects, which appear when you hover the cursor over a function or object. If you place the cursor over a toolbar button or menu option (but not a submenu name) a one-line description of the

menu option or tool bar button's function appears. If you place the cursor over a channel, event, or arrival object, additional information about these objects appears. Figures 21 through 23 show examples of quick-tips.

FIGURE 21. QUICK-TIP DESCRIBING TOOL BAR ALPH FUNCTION

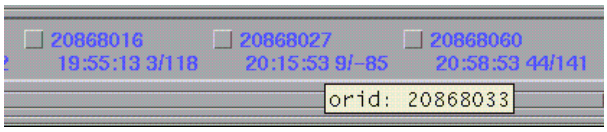


FIGURE 22. QUICK-TIP DISPLAYING ORID

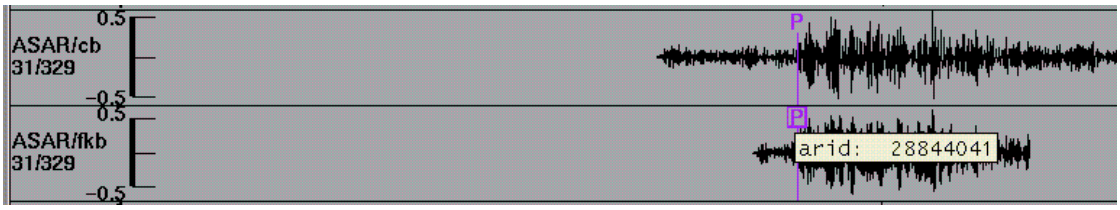


FIGURE 23. QUICK-TIP DISPLAYING ARID

Popup Menus

Popup menus also provide additional information about event, channel, or arrival objects, and provide easy access to functions specific to the object. By right-clicking on the event, channel, or arrival, you are provided with a list of menu items that you can select directly from the popup menu. For example, if you select a popup menu on a channel, functions commonly applied to channels such as fil-

tering or zooming appear. If you select a popup menu for an event, you can access information about each arrival associated to the event without having to search for them. Figures 24 through 26 show example popup menus.

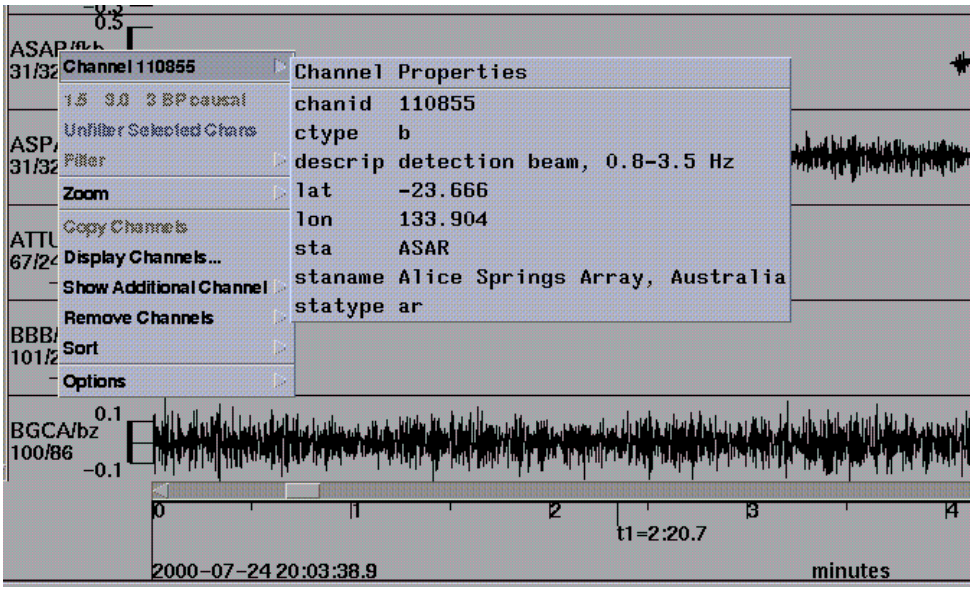


FIGURE 24. CHANNEL POPUP MENU

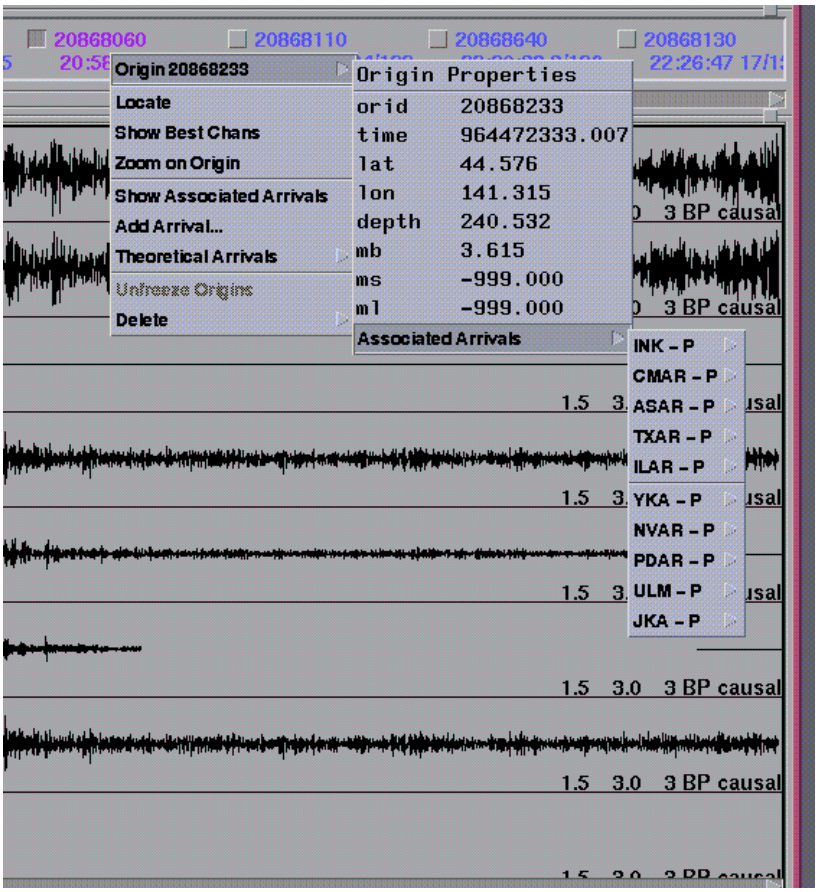


FIGURE 25. EVENT POPUP MENU

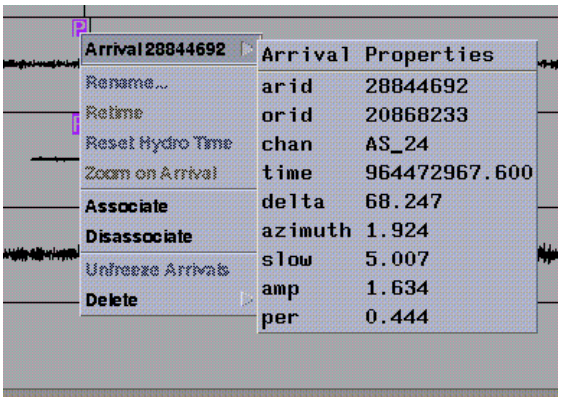


FIGURE 26. ARRIVAL POPUP MENU

Toolbar Button Functions

For accessibility, frequently used menu functions are provided on the *ARS* toolbar, as shown in Figure 27. These functions modify the waveform display, modify arrivals, or call associated tools. Toolbar buttons are displayed directly above the waveform display. Table 2 provides a list of the toolbar options. A detailed description of the functions follows Table 2.

FIGURE 27. ARS TOOLBAR

TABLE 2: ARS TOOLBAR FUNCTIONS

Tool	Description
Asc On	select associated phases
Co Ph	disassociate coda phases
Uftr	unfilter channel(s)

TABLE 2: ARS TOOLBAR FUNCTIONS (CONTINUED)

Tool	Description
Ph "P"	default phase
Ad Ph	add phase
Rn Ph	rename phase
Bm Ph	beam phase
AlPh	align on default phase
UnAl	unalign phase
SBD	sort by distance
SBU	sort by user-defined order
Th	display theoretical arrival time
Th O	undisplay theoretical arrivals
F-K	analyze azimuth and slowness using *XfkDisplay*
Beam	beam channel(s)
SlCh	select channel
Ele	select element
Loc	locate event
Rej	reject event
QC	perform quality check
Ufrz	unfreeze event
Sav	save event

Asc On - Select Associated Phases

The Asc On toolbar button selects all phases associated with the single selected event.

To select associated phases:

1. Select a single event.
2. Select AscOn from the *ARS* toolbar.

   All arrivals associated to the event are selected in the *ARS* waveform display. These can be seen in Figure 28 as having their phase label displayed in reverse video. The arrivals are also selected in AlphaList if it is displayed (see "Edit > AlphaList" on page 95).

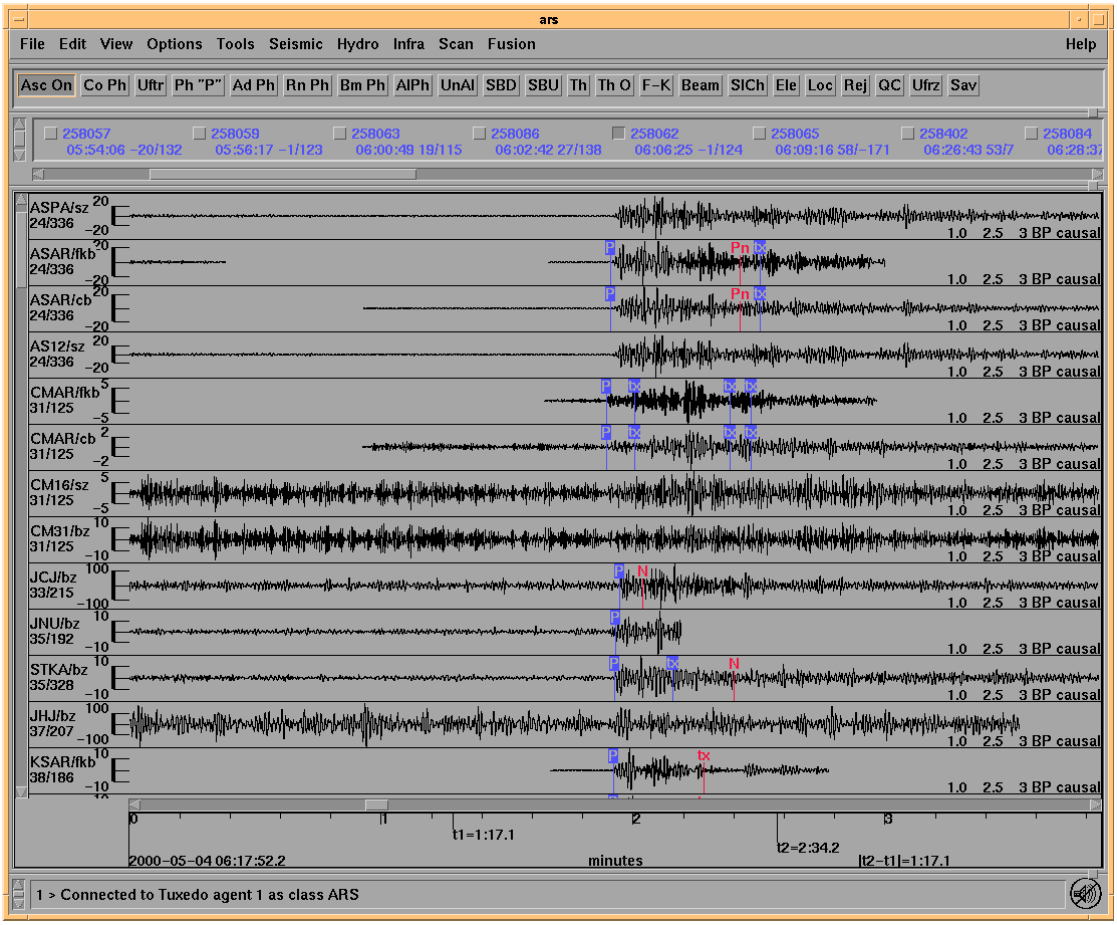


FIGURE 28. SELECT ASSOCIATED PHASES

Co Ph - Disassociate Coda Phases

The Co Ph toolbar button disassociates coda phases. Coda phases are generally defined as those arrivals, whether associated or not, that appear closely in time behind a main arrival and that have similar azimuth and slowness to the main arrival's phase type. These arrivals trigger the detector, but are not likely to be a distinct phase; they are reverberations following the appearance of the main phase and are not assigned travel times; they are assigned the suffix `x`, such as `Px` or `tx`, to distinguish them as coda to main phases. Although coda arrivals are often associated to an event by the Automatic Processing software, you may want to disassociate them to remove clutter from the display and AlphaList. Figure 29 shows an example where only coda phases are selected.

To disassociate a coda phase:

1. Select an event. (Be certain that no other arrivals are selected prior to selecting Co Ph or they will also be disassociated from the event.)
2. Select Co Ph from the *ARS* toolbar.

   All associated coda phases are added to the selection list, and then all selected arrivals are disassociated.

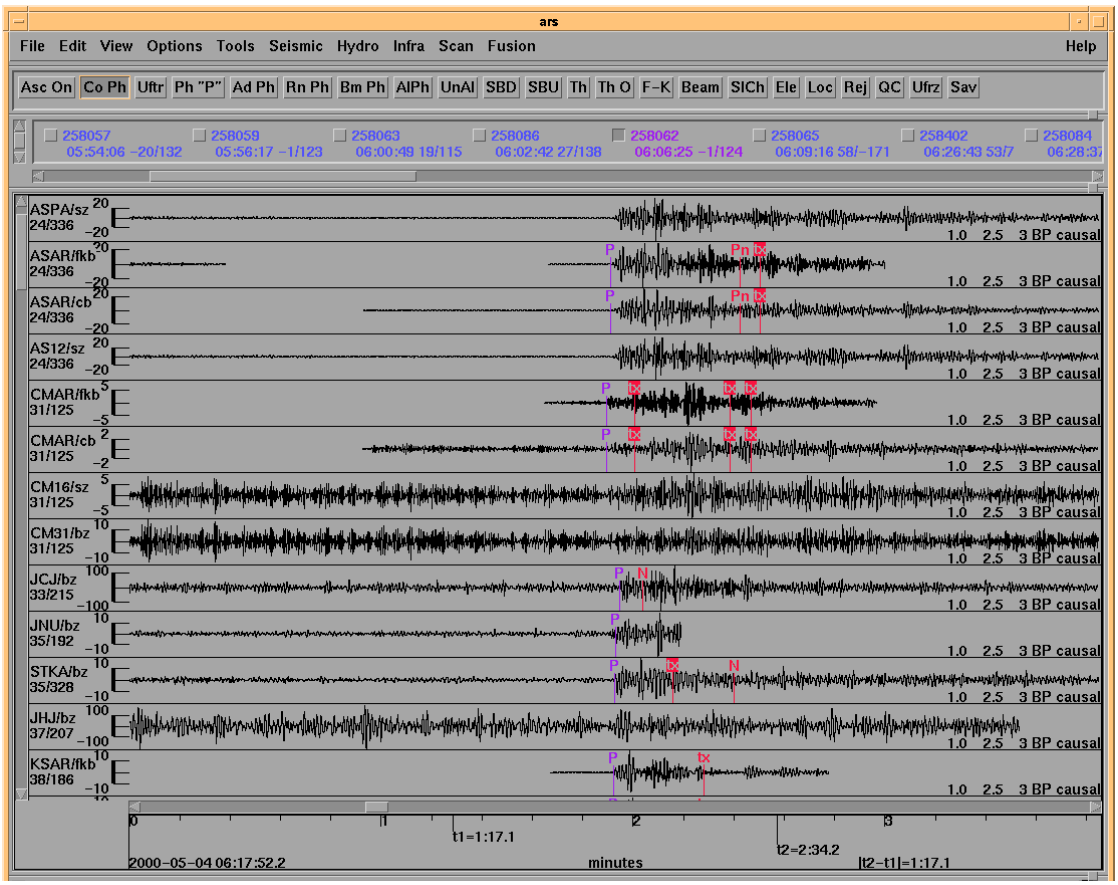


FIGURE 29. SELECT CODA PHASES

Uftr - Unfilter Channel(s)

The Uftr toolbar button unfilters one or more channels in the waveform display. Unfiltering redisplays the waveform in its raw waveform state without any filter applied to it. Figure 30 shows the Uftr button applied to three selected channels.

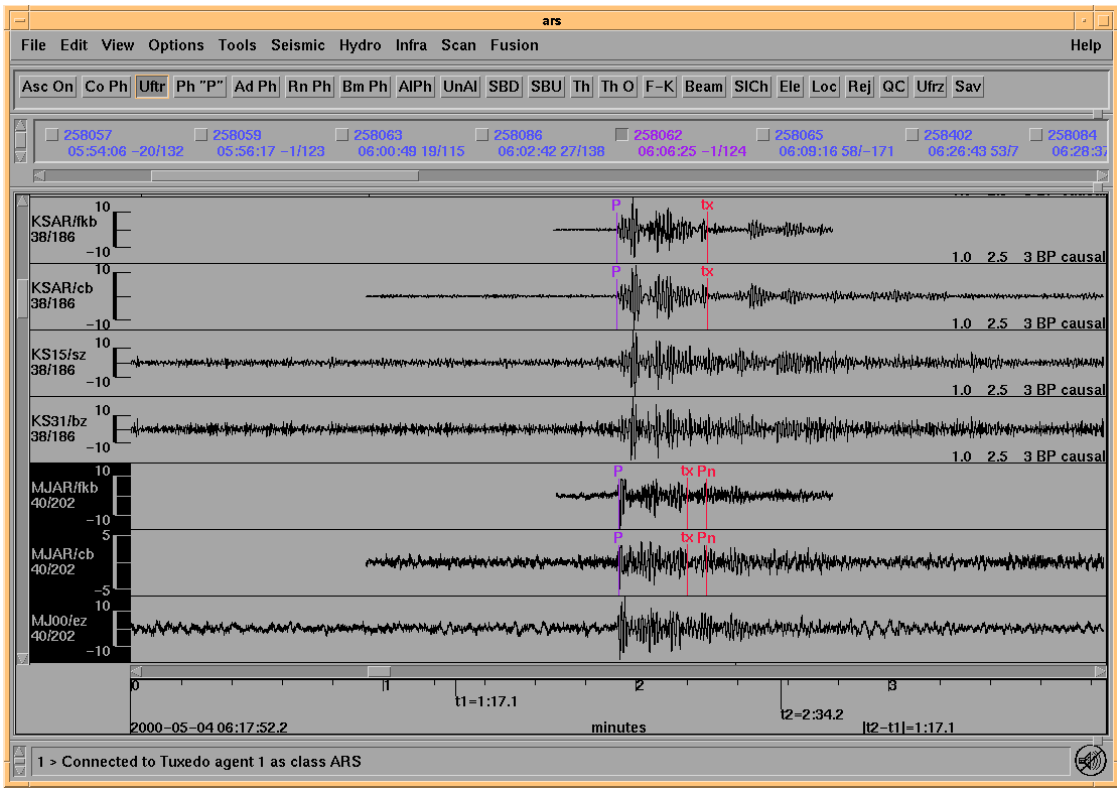


FIGURE 30. UNFILTER

To unfilter a channel(s):

1. Select a channel by clicking directly in the channel display to the left of the waveform. To select multiple channels, press the shift key while selecting channels with the left mouse button. To select all channels, press control-p.
2. Select Uftr from the *ARS* toolbar.

   The selected channel(s) display unfiltered waveform traces.

Ph "P" - Set Default Phase

The Ph "P" toolbar button both displays the current default phase and allows you to set the default phase. The default phase is used by several other toolbar buttons such as add phase (Ad Ph) and rename phase (Rn Ph). When *ARS* starts, the default phase is set to "P" so the button is labeled Ph "P", as shown in Figure 31. The default phase is also reset to "P" whenever events are saved or discarded. The button's label will update whenever the default phase is changed.

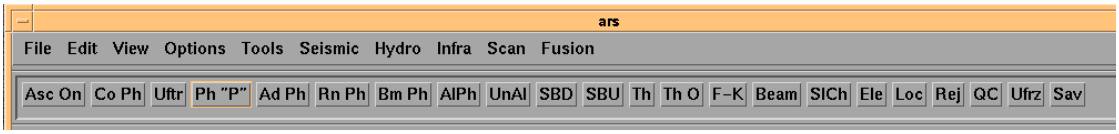
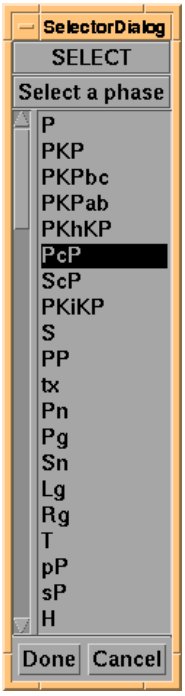

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav

FIGURE 31. SET DEFAULT PHASE BUTTON



To set the default phase:

1. Select Ph "P" from the *ARS* toolbar.

   A select phase dialogue box appears. It presents a scrolling list of the available S/H/I phase types.

2. Select the desired phase such as "PcP," as shown in Figure 32.

   The default phase becomes "PcP," and the Ph "P" label is updated, as shown in Figure 33.

FIGURE 32. SELECT PHASE DIALOGUE BOX

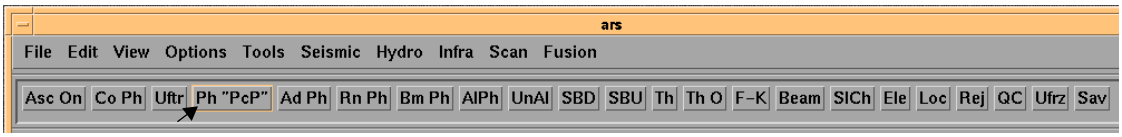

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion
Asc On Co Ph Uftr Ph "PcP" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SlCh Ele Loc Rej QC Ufrz Sav

FIGURE 33. SET DEFAULT PHASE BUTTON SHOWING PHASE "PCP"

Ad Ph – Add Phase

The Ad Ph toolbar button adds a default phase to the selected channel's waveform at the time marked by t1. The added arrivals are assigned the default phase type and a negative arrival identifier as shown in Figure 34. Arrivals must be added one at a time.

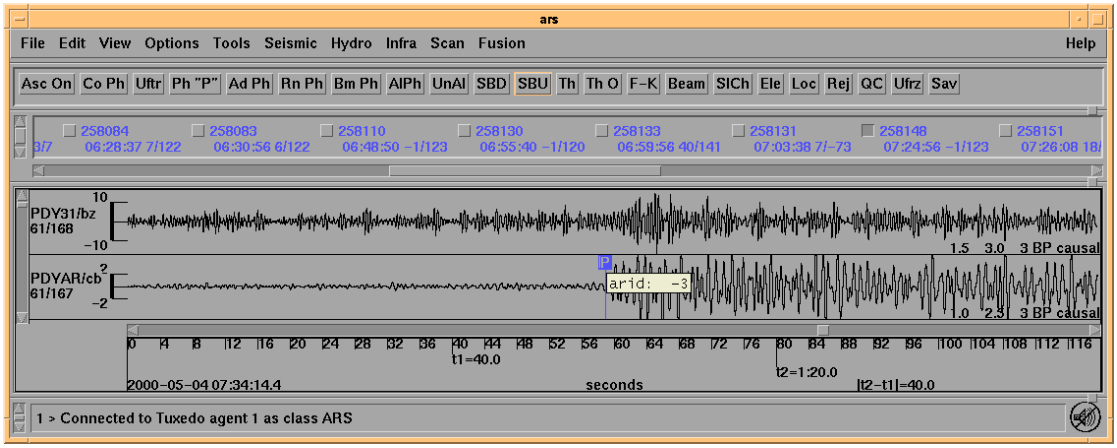

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SlCh Ele Loc Rej QC Ufrz Sav
PDY31/bz 61/168
PDYAR/cb 61/167
arid: -3
1.5 3.0 3 BP causal
1.0 2.5 3 BP causal
t1=40.0
t2=1:20.0
|t2-t1|=40.0
2000-05-04 07:34:14.4
seconds
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 34. ANALYST-ADDED PHASE

To add a phase:

1. Position t1 at the desired arrival time.
2. Select a channel.

3. Select Ad Ph from the *ARS* toolbar.

   An arrival is added to the selected channel and is given the default phase type. If an event is selected the arrival is automatically associated to the event.

Rn Ph – Rename Phase

The Rn Ph toolbar button renames a phase to the default phase, as shown in Figure 35.

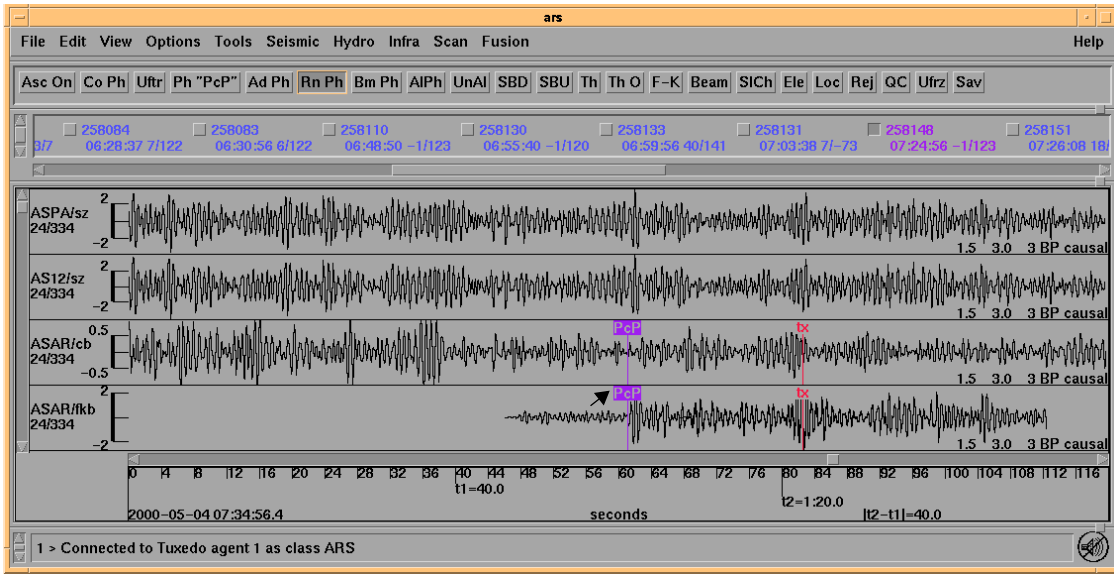

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "PcP" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SlCh Ele Loc Rej QC Ufrz Sav
ASPA/sz 24/334
AS12/sz 24/334
ASAR/cb 24/334
ASAR/fkb 24/334
PcP
tx
1.5 3.0 3 BP causal
t1=40.0
t2=1:20.0
|t2-t1|=40.0
2000-05-04 07:34:56.4
seconds
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 35. RENAMED PHASE

To rename a phase:

1. Select one arrival; you need not select an event.
2. Select Rn Ph from the *ARS* toolbar.

   The phase name changes to match the default phase name as shown on the default phase button. If a single event is selected the phase automatically is associated to the event.

Bm Ph – Beam Phase

Beamforming enhances coherent signals relative to background noise. Signal energy arriving at individual elements of an array is time-shifted and summed to emphasize energy arriving at the array from a particular direction, such as a theoretical event location. "Beaming" is performed by the *DFX* application [IDC7.1.1]. The Bm Ph button initiates interactive recall processing to have *DFX* form beamed data for the selected station around the selected arrival time oriented toward the selected event.

To create a beam for a selected phase type:

1. Select an event.
2. Select the fkb or cb beam channel of an array station.
3. Select an arrival to set the phase and time for beaming. You can select channels for more than one station to generate multiple beams.
4. Select Bm Ph from the *ARS* toolbar.

   A temporary, derived origin beam channel is created. The beam waveform spans several seconds before and after the selected arrival's theoretical arrival time, based on the origin time and location. Beaming by *DFX* takes several seconds, and no dialogue box is displayed while the beam is being processed. *ARS* is still active while beamforming occurs. When the beam is returned, the channels in *ARS* re-sort to accommodate the beam. They are sorted by distance to the event. Figure 36 shows a temporary beam channel for station CMAR.

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav
20867958 18:53:30 0/167
20867985 19:30:53 37/132
20868016 19:55:13 3/118
20868027 20:15:53 9/-85
20868060 20:58:53 44/141
20868110 22:10:37 24/122
20868640 22:20:39 3/126
20868130 22:26:47 17/1
CM31/bz 44/44
CMAR/cb 44/44
CMAR/CBtmp 44/44
CMAR/fkb 44/44
1.5 3.0 3 BP causal
P
N
t1=2:20.7
t2=4:41.5
2000-07-24 21:04:44.3
minutes
|t2-t1|=2:20.8
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 36. TEMPORARY BEAM CHANNEL

AlPh – Align on Default Phase

The AlPh toolbar button aligns waveforms on the default phase's theoretical arrival time as determined by the event's current location and origin time, and the theoretical travel time from the event to the station.

To align waveforms on the default phase:

1. Select an event.
2. Set the default phase if necessary.
3. Select AlPh from the *ARS* toolbar.

   All waveforms are time shifted to align to the default phase's theoretical arrival time at each station.

UnAl – Unalign Phase

The UnAl toolbar button unaligns waveforms. This function removes any time shifting of the waveforms and displays all channels on the same relative time axis.

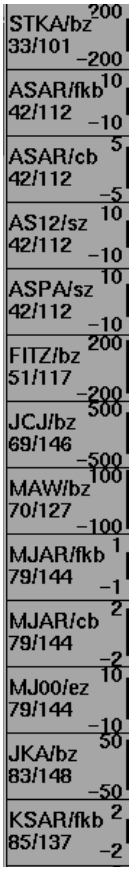
To unalign a phase:

1. Select UnAl from the *ARS* toolbar.

   The waveforms in *ARS* realign to absolute time. They no longer are aligned on any theoretical travel time or origin time.

SBD – Sort by Distance

The SBD toolbar button sorts channels by distance from the event based on the event's current location.



To sort by distance:

1. Select an event.
2. Select SBD from the *ARS* toolbar.

   Channels are displayed in order of increasing distance from the selected event's current location. The closest station to the event appears at the top of the *ARS* screen; the furthest station from the event appears at the bottom. The left bottom number in the channel information display indicates great circle distance from the event in degrees (Figure 37).

FIGURE 37. SORT BY DISTANCE FUNCTION

SBU – Sort by User-defined Order

The SBU toolbar button moves user-selected channels to the top of the *ARS* waveform display.

To sort by user-defined order:

1. Select one or more channels to be sorted to the top of *ARS* display. To select more than one channel, press the Shift key while selecting multiple stations, one at a time.

2. Select SBU from the *ARS* toolbar.

   All selected channels are shown at the top of the *ARS* display, as shown in Figure 38.

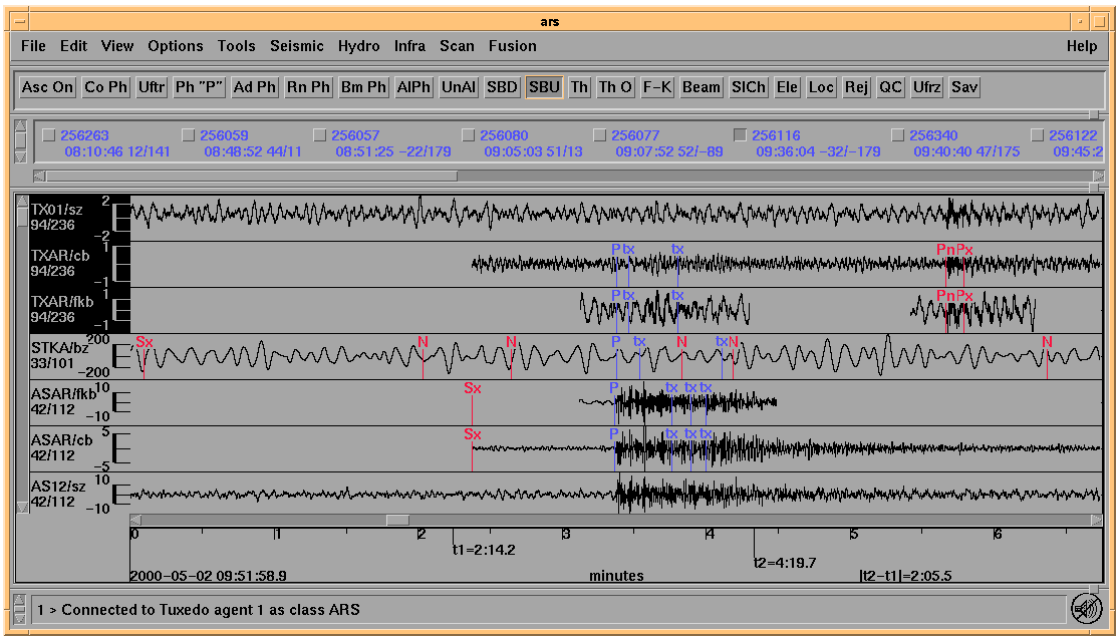


FIGURE 38. SORT BY USER-DEFINED ORDER

Th – Theoretical Arrival Time

The Th toolbar button displays the selected phase's theoretical arrival time. The theoreticals displayed are based on the event's current location and origin time and on standard travel time curves for the phase.

To display the theoretical arrival time:

1. Select an event.
2. Select channel(s) on which theoretical phases should be displayed.
3. Select Th from the *ARS toolbar*.

   A list of phases is displayed.

4. Select one phase for which theoreticals should be displayed.

   The arrival's theoretical arrival time is displayed on the selected channel(s). If waveforms are aligned on the theoretical phase, theoreticals appear vertically aligned in the middle of the waveform display, as shown in Figure 39.

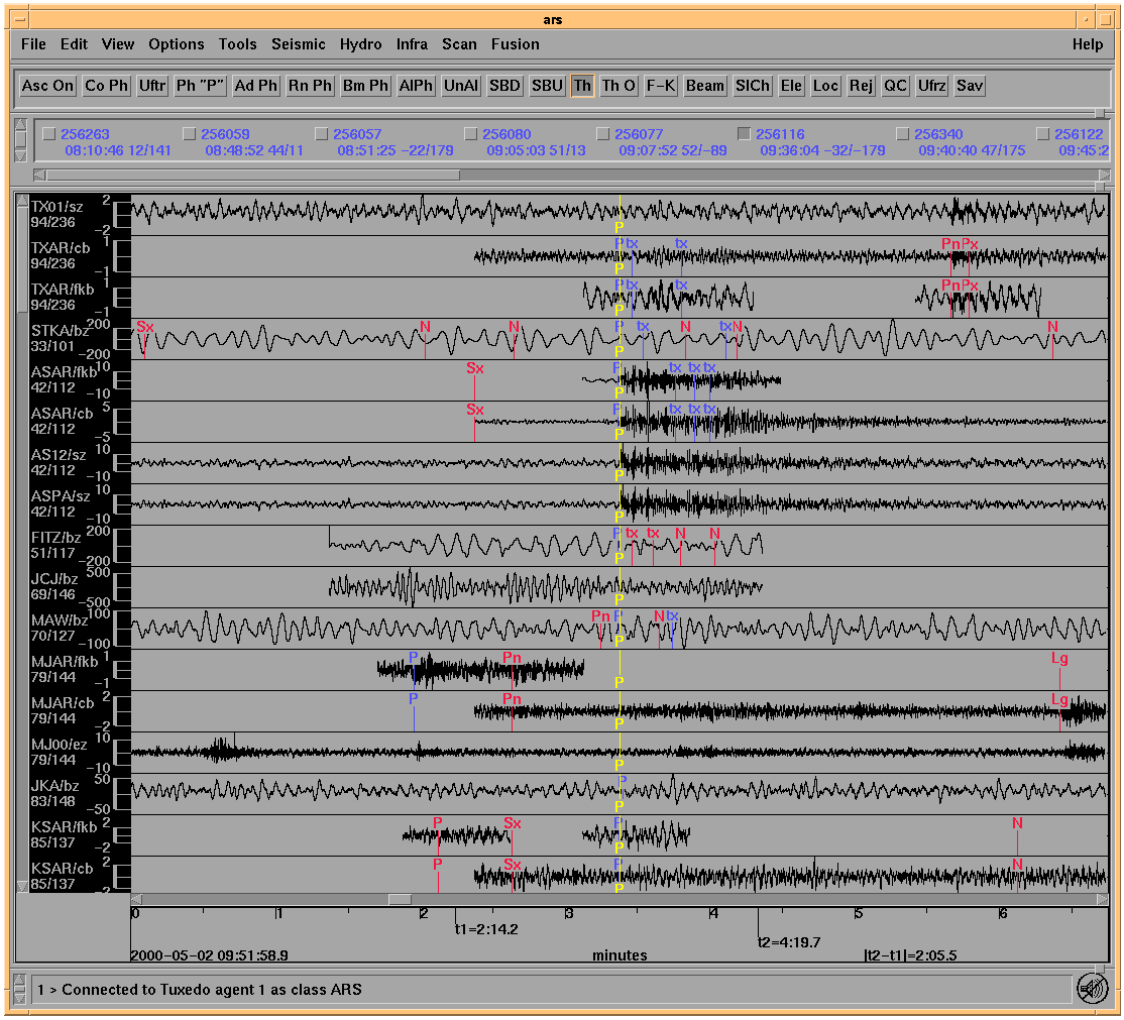


FIGURE 39. DISPLAYING THEORETICAL ARRIVAL TIMES

Th O – Theoretical Times Off

The Th O toolbar button removes theoretical arrival times to avoid clutter. After selecting a new event or updating an event location, displayed theoreticals are no longer current and should be removed.

To remove theoretical arrival times:

1. Select Th O from the *ARS* toolbar. Channels do not have to be selected.

   All theoretical phases are removed from the *ARS* display.

F-K – Analyze Azimuth and Slowness using XfkDisplay

The F-K toolbar button launches *XfkDisplay*. This program allows you to visually interpret the station-to-event azimuth and slowness for an arrival.

To analyze azimuth and slowness using *XfkDisplay*:

1. Select an arrival. To select more than one arrival to send to *XfkDisplay*, press the Shift key while selecting the arrivals one at a time.
2. Select F-K from the *ARS* toolbar.

   XfkDisplay launches, and you can now analyze the arrival's azimuth and slowness. You can also return updated azimuth and slowness parameters to *ARS*. See "XfkDisplay Procedures" on page 201.

Beam – Beam Channel

Beamforming enhances coherent signals relative to background noise. Signal energy arriving at individual elements of an array is time-shifted and summed to emphasize energy arriving at the array from a particular direction, such as a theoretical event location. "Beaming" is performed by the *DFX* application [IDC7.1.1]. The Beam toolbar button initiates interactive recall processing to have *DFX* form beamed data for the selected station around the selected theoretical arrival time oriented toward the selected event. The Beam function behaves the same as the function Bm Ph (Beam Phase), except it allows interactive phase selection and brings up a cancellable dialogue box during processing.

To beam a channel:

1. Select an event.
2. Select either the fk beam or cb beam on an array station (a cb derived channel is always returned). You can select channels for more than one station to generate multiple beams.
3. Select Beam from the *ARS* toolbar.

   A list of phases appears.
4. Select the phase on which to beam.

   This determines the theoretical arrival time around which the beam interval is created. An *ARS* dialogue box appears during beam processing, locking the *ARS* screen. Beaming should take approximately 15 seconds, after which time the *ARS* screen is released, and the appropriate beam appears. The beam is sorted by distance from the event and aligned on the theoretical arrival time of the selected phase.

SICh – Select Channel

ARS displays a default set of channels for each station. The SICh toolbar button allows you to select additional channel components for display in *ARS*, as shown in Figure 40.

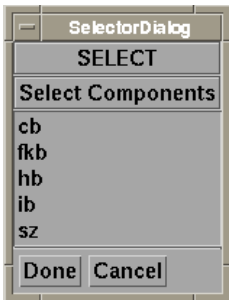


FIGURE 40. CHANNEL COMPONENTS SELECTION BOX

To select a channel:

1. Select any channel in a station.
2. Select SlCh from the *ARS* toolbar.

   A list of the station's components is displayed, as shown in Figure 40.
3. Select a channel type from the list of components, then click Done.

   ARS displays all traces belonging to the selected channel type. The channel(s) appear, sorted by distance from the event, usually along with the other components of that station. They appear as unfiltered traces, but are aligned on the default phase. These added channels remain displayed for the duration of the *ARS* session or until you remove them manually (see " View > Remove Channels" on page 113).

Ele – Element

The Ele toolbar button allows you to select and display individual elements of a station.

To select an element:

1. Select a channel.
2. Select Ele from the *ARS* toolbar.
3. Select a channel from the list of elements, as shown in Figure 41, then click Done.

   ARS displays the element. The channel is sorted by distance to the event, usually along with the other elements of the selected station's channels. It appears as an unfiltered trace, but is aligned on the default phase.

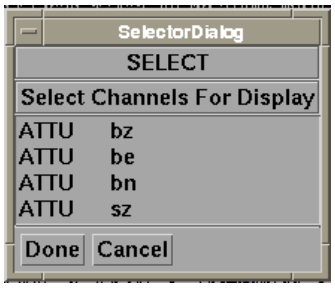


FIGURE 41. CHANNEL SELECTION DIALOGUE BOX

Loc – Locate

The Locate toolbar button computes a location using the arrival time, azimuth, and slowness of the associated arrivals (see [IDC5.2.1]). *ARS* uses a grid-point convergence algorithm to compute a location, then displays a Location dialogue box and a Magnitude dialogue box on the screen opposite the one displaying *ARS* (Figures 42 and 43). These boxes contain the location information, the computed surface and depth solutions, and station and event magnitude (Figures 44 and 45) (see "Locator Dialogue Box" on page 187 and "Magnitude Dialogue Box" on page 194).

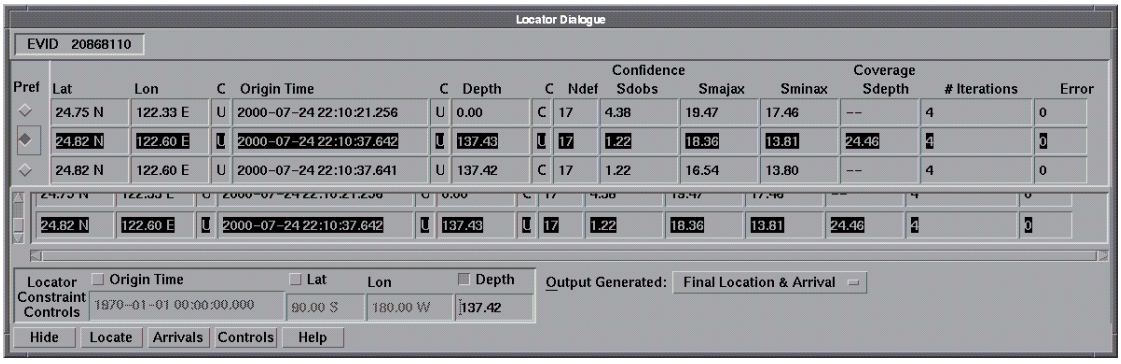

Locator Dialogue
EVID 20868110
Pref Lat Lon C Origin Time C Depth C Ndef Confidence Sdobs Smajax Sminax Coverage Sdepth # Iterations Error
24.75 N 122.33 E U 2000-07-24 22:10:21.256 U 0.00 C 17 4.38 19.47 17.46 -- 4 0
24.82 N 122.60 E U 2000-07-24 22:10:37.642 U 137.43 U 17 1.22 18.36 13.81 24.46 4 0
24.82 N 122.60 E U 2000-07-24 22:10:37.641 U 137.42 C 17 1.22 16.54 13.80 -- 4 0
24.82 N 122.60 E U 2000-07-24 22:10:37.642 U 137.43 U 17 1.22 18.36 13.81 24.46 4 0
Locator Constraint Controls
Origin Time
1970-01-01 00:00:00.000
Lat
90.00 S
Lon
180.00 W
Depth
137.42
Output Generated:
Final Location & Arrival
Hide
Locate
Arrivals
Controls
Help

FIGURE 42. LOCATOR DIALOGUE BOX

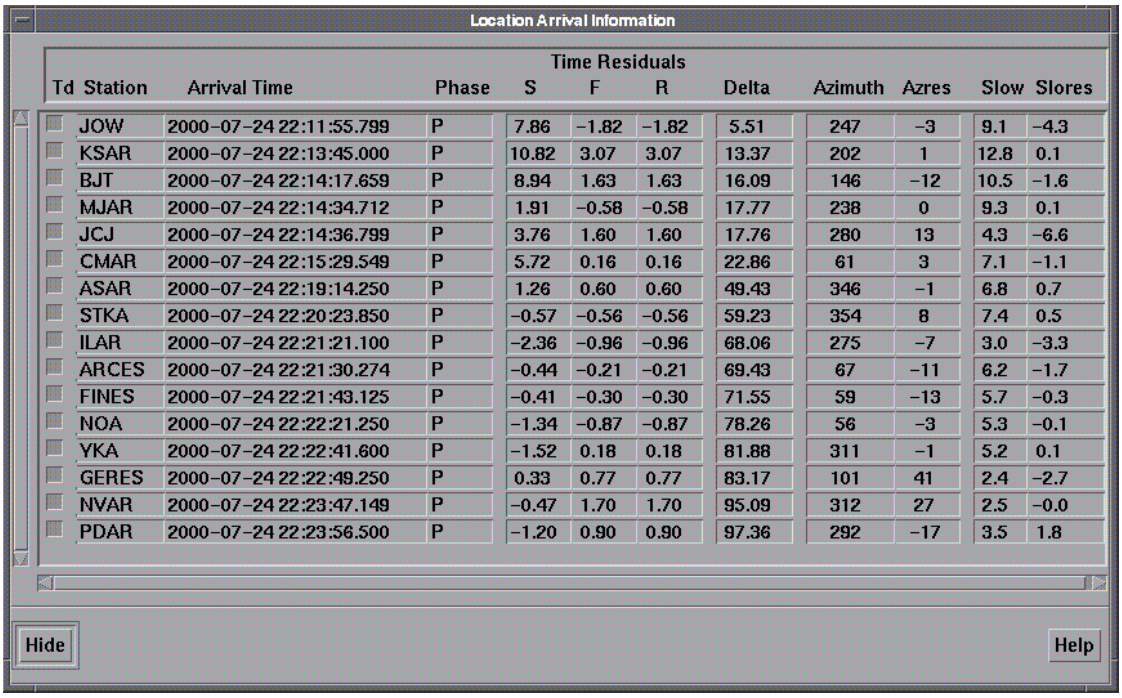


FIGURE 43. ASSOCIATED ARRIVALS DIALOGUE BOX

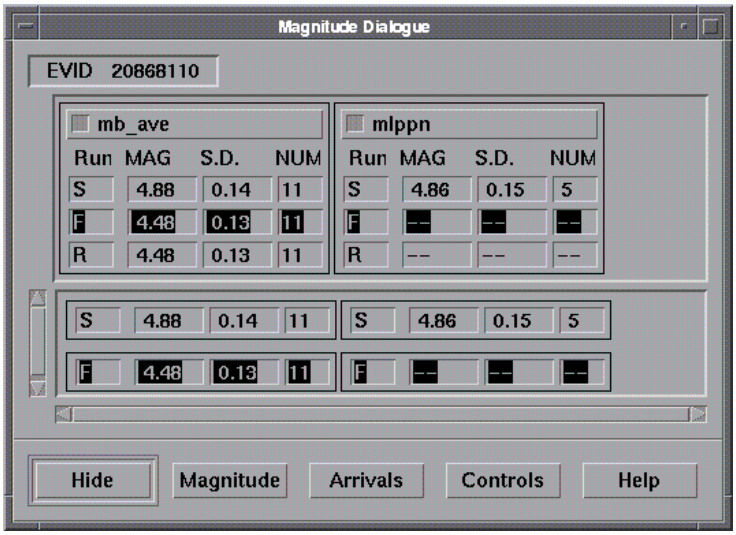


FIGURE 44. MAGNITUDE DIALOGUE BOX

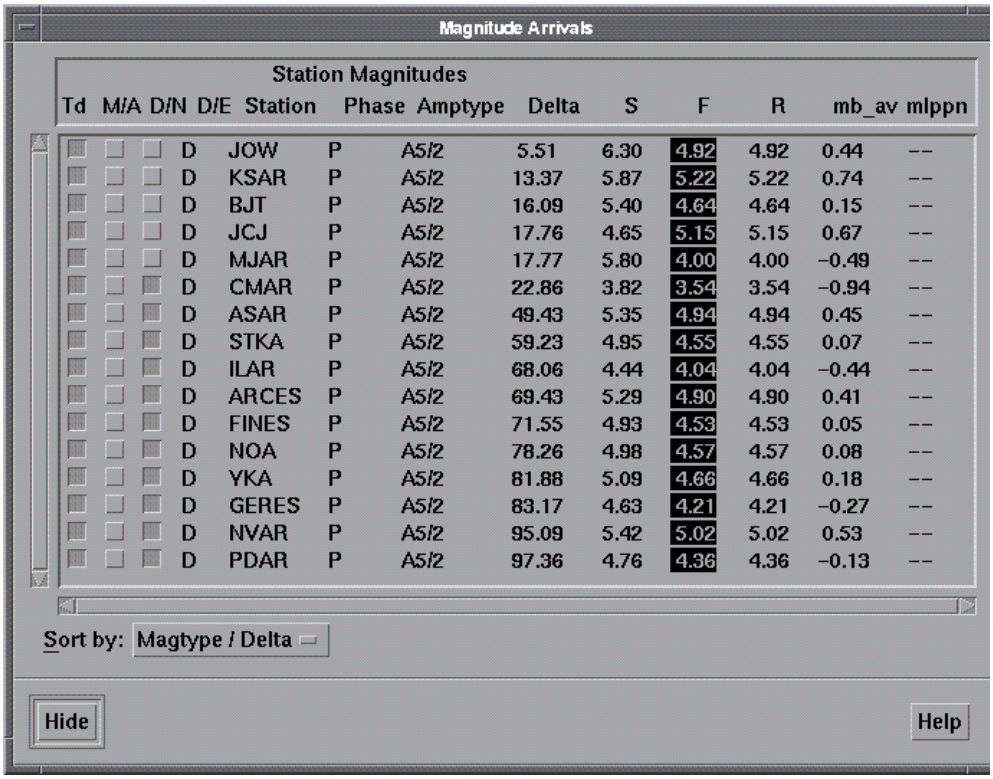


FIGURE 45. MAGNITUDE ARRIVALS DIALOGUE BOX

To locate an event:

1. Select an event.
2. Select Locate from the *ARS* toolbar. Arrivals or channels need not be selected.

   ARS locates the event. The location is displayed in the Locator dialogue box. The event information in AlphaList (see page 95) and the event scroll bar at the top of the *ARS* screen are also updated. Arrival information in AlphaList is updated. Theoretical arrival times are adjusted.

The Locator dialogue box (Figure 42) contains locations for three possible depth solutions: S = Surface, F = Free, and R = Fixed. The latitude and longitude of the event, the time of the event, the calculated depth, the number of defining phases, the location standard error and error ellipse information, and standard error on the depth are displayed in the Locator dialogue box. The number of iterations required to converge on a location is also displayed. Several functions can be accessed through the Locator dialogue box, including the Arrivals option, which displays detailed information about the arrivals contributing to the location, and a Controls option, which provides additional options to constrain the location. More information about the Locator dialogue box is provided on page 187.

The Magnitude dialogue box (Figure 44) provides output from the mb_ave and ml_ppn event or netmag calculation. (The term netmag is short for network magnitude and is used to describe the magnitude of an event, using all the associated arrival stamags in the network. The term stamag is short for individual station magnitude. A stamag is calculated from the period and amplitude information measured from each individual associated arrival that contributes to the magnitude calculation.) The Magnitude dialogue box displays the magnitude for each calculated depth solution and highlights the preferred depth solution. The preferred solution is selected automatically as the one producing the smallest error ellipse. You may change the preferred solution by selecting the small square Pref, which is next to the preferred solution in the Locator dialogue box (Figure 42). *ARS* calculates both an *mb_ave* and *ml_ppn*. The *mb_ave* is the averaged bodywave magnitude, calculated for stations between 20 and 100 degrees distance from an event. The *ml_ppn* is the averaged local magnitude calculated for stations less than 20 degrees from events that are less than 40 km deep. The magnitude, standard error, and number of defining phases are displayed in the Magnitude dialogue box for both types of magnitudes (Figure 44). Like the Locator dialogue box, the Magnitude dialogue box provides several options, including the Arrivals option to display more detailed information about the individual phases contributing to the event magnitude (Figure 45). See "Magnitude Dialogue Box" on page 194 for more information.

Rej – Reject Event

The Rej toolbar button discards or rejects an automated, system-generated event that you determine to be improperly defined. Rejecting an event invalidates it so that it does not appear in the Reviewed Event Bulletin (REB).

To reject an event:

1. Select and analyze an event.
2. After determining the event is not valid, discard it by selecting Rej from the *ARS* toolbar.

   ARS prompts you with a list of reasons for rejection, as shown in Figure 46.
3. Select one or more discard reason, then click Done.

   The event identification (*evid*), analyst ID, and rejection reasons are added to the **discard** table. The event label turns brown, as shown in Figure 47. This indicates that the event has been discarded and will not become part of the published bulletin.

FIGURE 46. REASONS FOR REJECTING EVENT

FIGURE 47. REJECTED EVENT

QC – Quality Check

The QC toolbar button performs a quality check on events. These checks notify you of timing and residual errors, improper associations, invalid phase names, improper defining parameters, errors on depth phase associations, and other less common errors. Normally you will want to wait until completing your analysis of an event before invoking QC.

To QC an event:

1. Select QC from the *ARS* toolbar.

   The screen becomes locked while the quality check is run.

   When the quality check is complete, a popup text window appears on top of the *ARS* window. This popup window provides the results of the quality check, as shown in Figure 48. Events must meet a minimum number of weighting criteria to be published in the REB. The criteria are defined in [IDC5.2.1]. Criteria are translated into points in *ARS*. For example, a time defining phase is assigned 1 point. The QC output indicates whether an event has sufficient points to be properly saved to the database for inclusion in the REB. The QC output flags most errors, including residual errors, improper defining parameters, and so forth. You must fix these errors before saving the event. The QC provides warnings only; it does not prevent *ARS* from saving the event.

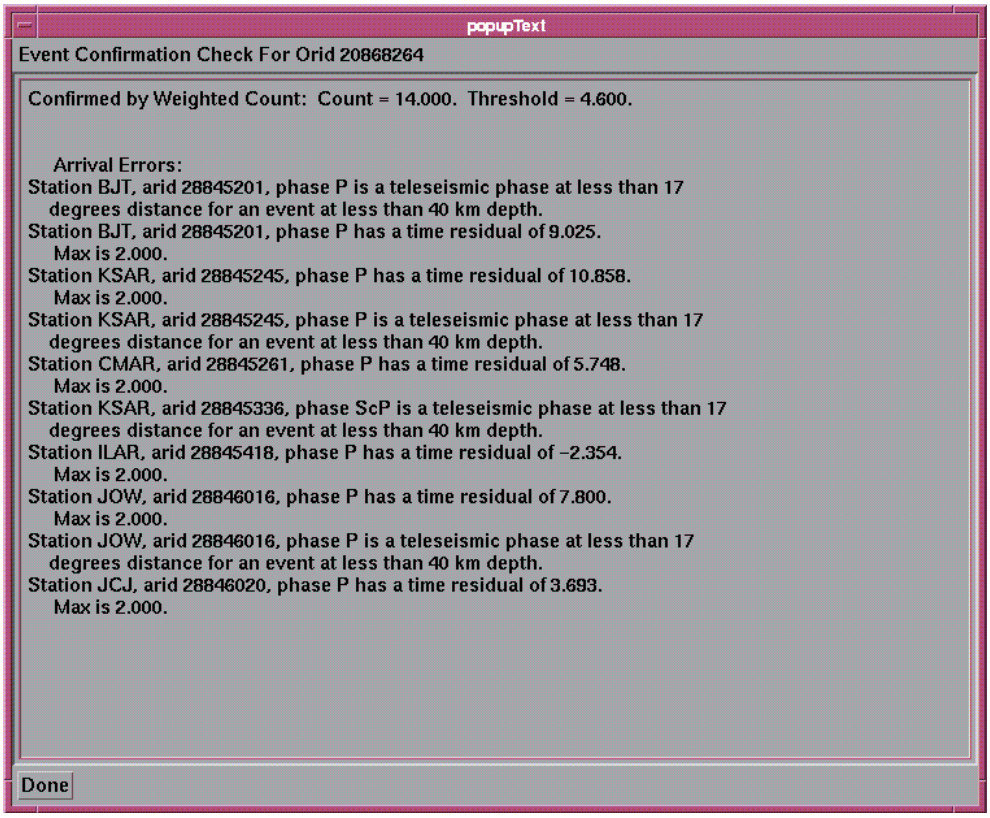

popupText
Event Confirmation Check For Orid 20868264
Confirmed by Weighted Count: Count = 14.000. Threshold = 4.600.
Arrival Errors:
Station BJT, arid 28845201, phase P is a teleseismic phase at less than 17 degrees distance for an event at less than 40 km depth.
Station BJT, arid 28845201, phase P has a time residual of 9.025. Max is 2.000.
Station KSAR, arid 28845245, phase P has a time residual of 10.858. Max is 2.000.
Station KSAR, arid 28845245, phase P is a teleseismic phase at less than 17 degrees distance for an event at less than 40 km depth.
Station CMAR, arid 28845261, phase P has a time residual of 5.748. Max is 2.000.
Station KSAR, arid 28845336, phase ScP is a teleseismic phase at less than 17 degrees distance for an event at less than 40 km depth.
Station ILAR, arid 28845418, phase P has a time residual of −2.354. Max is 2.000.
Station JOW, arid 28846016, phase P has a time residual of 7.800. Max is 2.000.
Station JOW, arid 28846016, phase P is a teleseismic phase at less than 17 degrees distance for an event at less than 40 km depth.
Station JCJ, arid 28846020, phase P has a time residual of 3.693. Max is 2.000.
Done

FIGURE 48. EXAMPLE OF QC OUTPUT FROM EVENT

Ufrz – Unfreeze event

Occasionally you may change your opinion of an event. Additional data may become available after you have saved an event, or you may want to reverse a previous decision or make a questionable phase non-defining. You cannot change an event that is in the frozen or saved state; you must first unfreeze the event to make changes. The Ufrz toolbar button unfreezes an event.

To unfreeze a saved event:

1. Select the event.

2. Select Ufrz from the *ARS* toolbar.

   The event label and associated arrival bars and phase labels, which were green in the saved state, now turn blue, as shown in Figure 49. Event parameters saved in the LEB database are removed and are only retained in *ARS*. (If *ARS* is terminated without re-saving the event, the event's attributes revert to those set in the input SEL3 database.)

3. You can now modify the event. Save or discard the event after reanalysis; all events must be in either a saved or discarded state at the end of analysis.

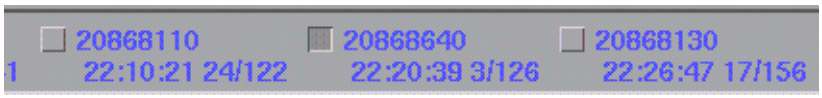


FIGURE 49. UNFROZEN EVENT

Sav – Save event

The Sav toolbar button saves an event. After completing analysis on a valid event, you must save the event.

To save an event:

1. Select and perform analysis on an event.
2. Perform a final location, and run QC on the event to make sure that it adheres to the rules defined for saving an event.
3. Select Sav from the *ARS* toolbar.

   The event and its associated arrivals are saved in the LEB database. To indicate the saved or frozen state, the event label, associated arrival bars, and phase labels turn green, as shown in Figure 50. Neither the event nor associated arrivals can be modified without unfreezing.

An event appears in the REB only if it has been saved in *ARS*. If you do not save an event before exiting the *ARS* session, any changes made to the event during that session are lost.

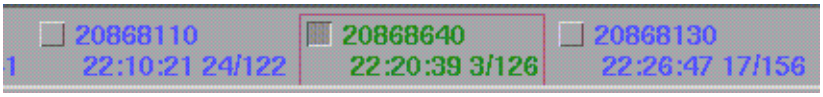


FIGURE 50. SAVED EVENT

ARS Menus

The *ARS* menus are organized by function. Related functions are grouped.

File Menu

The File menu lists functions that read, write, or affect data saved in the database. The *ARS* File menu is shown in Figure 51.

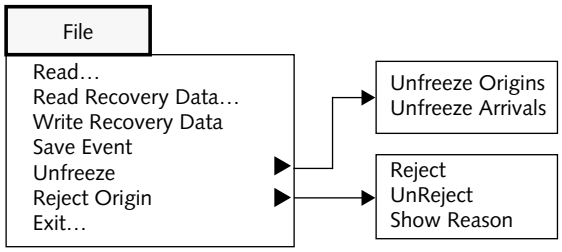


FIGURE 51. FILE MENU

File > Read…

The Read menu option is usually the first option that you choose in an *ARS* session. Read displays a dialogue box through which you can specify the date and time, the duration, the network, and the database account of the data to be read.

To specify data to be read:

1. With a new *ARS* session, choose File > Read.

   ARS displays a dialogue box with the date and time interval of requested data, the network, and the database from which data is to be loaded. The suggested values are taken from the file `ARS.load`, which is located in your home directory and generated by *analyst_log*.

2. Verify the information, then click Done.

   The waveform data, event information, arrivals, and channel display are loaded into *ARS*. This process typically takes about 5 minutes for a time block of 4 hours.

When data are first read *ARS* displays the full time window. Each technology has display window limits beyond which the waveforms will display as flat line traces. These limits are 30 minutes for seismic, 1.5 hours for hydroacoustic, and 5 hours for infrasonic. If the time interval being loaded into *ARS* is greater than these limits, you will need to zoom in to a smaller time window to view actual waveforms. The arrivals bars will be displayed at larger time windows, but may have their phase labels omitted. The "Options Menu" on page 129 provides options for showing and unshowing these display items.

File > Read Recovery Data...

The Read Recovery Data menu option recovers changes that you have made, if you lose your *ARS* session either through system failure or abnormal *ARS* termination.

To read recovery data:

1. Upon starting a new *ARS* session after an abnormal exit,[1] instead of selecting Read, choose File > Read Recovery Data.

1. Use *dman* to restart *ARS* instead of the *ARS* button in *analyst_log*, which will unsuccessfully attempt to start another *dman*.

2. Follow the same procedures as with the Read option.

   You are presented with a popup window containing the information that you requested.

3. Review the data in the popup window, then click Done.

   ARS loads the data that you were working on before the crash.

   The previous session is returned with any changes you made to arrivals, parameter measurements such as *DFX* and *XfkDisplay* results, and updated event locations. The status of the events is preserved as either saved or discarded. However, the *ARS* functional state is not preserved from the previous session. Such things as zoom level, selected objects, and applied filters are not retained. Only updates to event and arrival characteristics are preserved.

File > Write Recovery Data

The Write Recovery Data menu option directs *ARS* to save the current session into a UNIX binary file. The binary file is read using the Read Recovery Data option. *ARS* automatically saves recovery data during database access operations. These operations include saving, rejecting, unfreezing, or undiscarding an event. This option allows you to manually save recovery data at your discretion (for example, when working on a large event). You should not have to use this feature routinely, because it is regularly invoked automatically.

To write recovery data:

1. Choose File > Write Recovery at any point during analysis to save the current session updates.

   The recovery data are saved.

File > Save Event

The Save Event menu option saves an analyzed event to the database. In an operational setting, saved events are published in the REB.

To save an event:

1. Select and perform analysis on an event.
2. Complete analysis, perform a final location, and QC the event.
3. Choose File > Save Event.

   Event data are saved, and the event becomes frozen.

The event appears in the REB only if you have saved it in *ARS*. If you do not save the event and you exit the *ARS* session, any changes you made to the event are lost.

File > Unfreeze

The Unfreeze menu option provides two submenu options: Unfreeze Origins and Unfreeze Arrivals, as shown in Figure 52. These options allow you to unfreeze an origin or arrival(s) and make modifications.

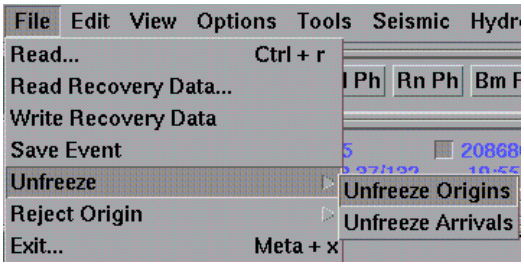


FIGURE 52. UNFREEZE SUBMENU

File > Unfreeze > Unfreeze Origins

The Unfreeze Origins menu option is the same as Ufrz in the *ARS* toolbar.

Occasionally, you may change your opinion of an event. Sometimes additional data become available after you have saved an event, or you may want to make a questionable phase non-defining. You cannot make changes to an event that has

been saved; you must first unfreeze the event. The Unfreeze Origins menu option unfreezes an event and its associated arrivals. Only after the event is unfrozen can you make changes, relocate, and save the event.

To unfreeze origins:

1. Select the saved event that you want to modify.
2. Choose File > Unfreeze > Unfreeze Origins.

   The event, which was labeled green while it was in the saved state, now turns blue. All of the arrivals also become unfrozen and turn blue. The event is now ready for modifications.
3. Modify the event as necessary.
4. Save or discard the event after reanalysis. All SEL3 (Standard Event List) events should be either in a saved or discarded state at the end of your analysis session, or the changes will be lost.

File > Unfreeze > Unfreeze Arrivals

The Unfreeze Arrivals menu option allows you to unfreeze specific arrivals. You can only unfreeze an arrival if it is not associated to an event. If an arrival is associated to an event that is saved, you must unfreeze the entire event.

To unfreeze arrivals:

1. Select the unassociated, saved arrival.
2. Choose File > Unfreeze > Unfreeze Arrivals.

   The individual arrival turns blue and can now be modified. If the arrival is associated to a saved event, *ARS* provides a warning that you must first unfreeze the entire event.

File > Reject Origin

ARS provides several submenu options for handling rejected or discarded events (Figure 53). Discarded events are events that you have determined are not valid either because of false association or because the event criteria for saving have not been met. Discarded events are put in the **discard** table and do not move to the REB.

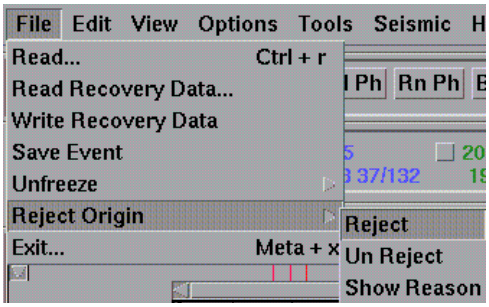


FIGURE 53. REJECT ORIGIN SUBMENU

File > Reject Origin > Reject

The Reject Origin > Reject menu option is the same function as Rej on the *ARS* toolbar and rejects an event by adding it to the **discard** table.

To reject an event:

1. Select and analyze an event.
2. After determining that the event is not valid, choose File > Reject Origin > Reject to discard the event.

   ARS displays a list of selectable reasons for why the event should be rejected (see Figure 46 on page 64).
3. Select one or more reasons, then click Done.

   The event ID, analyst ID, and rejection reasons are added to the **discard** table. The event label turns brown to indicate that it has been discarded and will not become part of the published bulletin.

File > Reject Origin > Un Reject

The Un Reject menu option removes an event from the discard table. You must either save or reject events, which means that in an operational environment all events ultimately either appear in the REB, or they are put into a special **discard** table. If an event is in the **discard** table, it may still be analyzed and located, but it cannot be saved, and modifications are lost when the *ARS* session terminates. To save a discarded event as a legitimate event, you must remove the event from the **discard** table and save the event.

To unreject an event:

1. Select a rejected event. A rejected event is identified by its brown color in *ARS*.
2. Select Un Reject.

   The event will turn blue. It can now be saved to the database when it meets other criteria for saving an event.

File > Reject Origin > Show Reason

The Show Reason menu option displays the reason for why an event was rejected. Figure 54 shows an example. This option is useful if multiple analysts review the same time period (for example during review).

FIGURE 54. EXAMPLE REASON FOR REJECTING EVENT

To show reasons for rejecting an event:

1. Select the discarded event. Discarded events are identified by their brown color.
2. Choose File > Reject Origin > Show Reason.

   A dialogue box appears. It shows the evid, the analyst who discarded the event, the date that the event was discarded, and the reason(s) it was discarded.

File > Exit...

The Exit... menu option terminates the *ARS* session.

To exit the session:

1. Choose File > Exit...

   ARS may give one of two warnings. If no modifications have been made, or all modifications have been saved, *ARS* confirms the action to exit with the message: `Exit ARS?`, as shown in Figure 55.
2. Click Confirm to exit the session or Cancel to return to the current session.

   If modifications to arrivals or events have been made and not saved, *ARS* provides a confirmation window with a list of all the modifications.

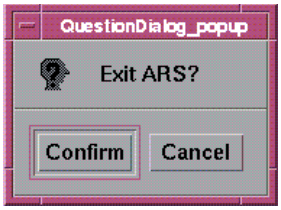


FIGURE 55. ARS PROMPT WHEN EXITING SESSION

Edit Menu

The Edit menu contains options that edit events and arrivals, as shown in Figure 56. These menu functions may be applied to data belonging to any of the three time-series technologies. Technology-specific functions are accessed through the Seismic, Hydro, or Infra menus.

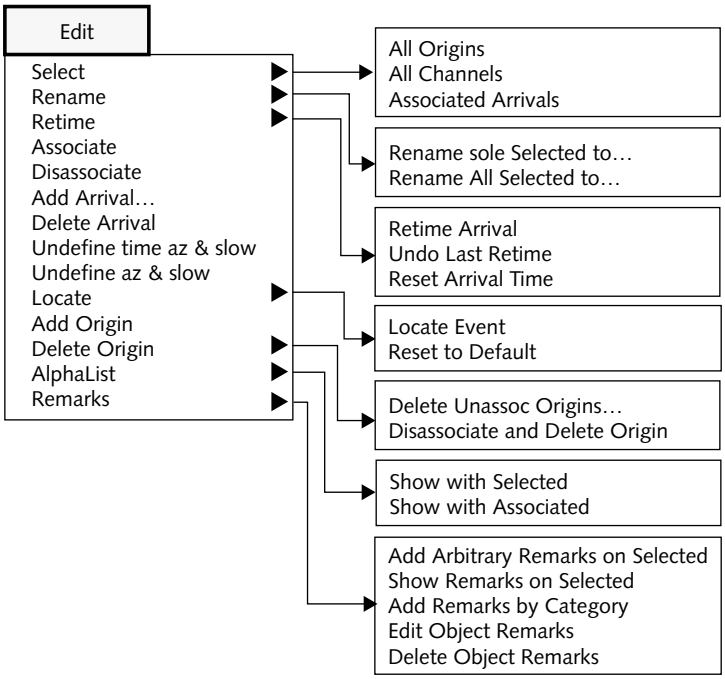


FIGURE 56. ARS EDIT MENU

Edit > Select

The Select submenu provides shortcuts for selecting groups of objects instead of having to select each object individually. These shortcuts are shown in Figure 57.

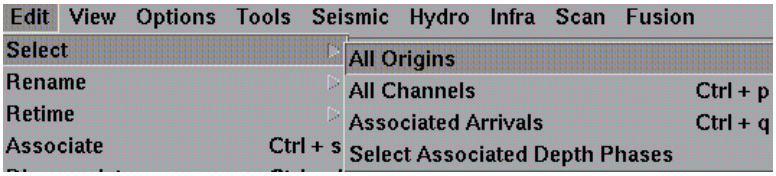


FIGURE 57. SELECT OPTIONS UNDER EDIT MENU

Edit > Select > All Origins

The All Origins menu option selects all origins, for example, to plot all event locations on a map or display an AlphaList to compare all locations.

To select all origins:

1. Choose Edit > Select > All Origins.

   All the origins in your allocated time period are selected. The process for selecting all origins takes about 30 seconds, but is considerably faster than individual manual selection.

2. Apply other operations to the selected events.

Edit > Select > All Channels

The Select > All Channels menu option selects all channels that are displayed in the *ARS* window so that you can apply certain functions, such as filtering, to all channels at the same time.

To select all channels:

1. Choose Edit > Select > All Channels. You need not select an event.

   All channels in the *ARS* display become highlighted, indicating that they have been selected (see Figure 58).

2. Apply other operations to the selected channels.

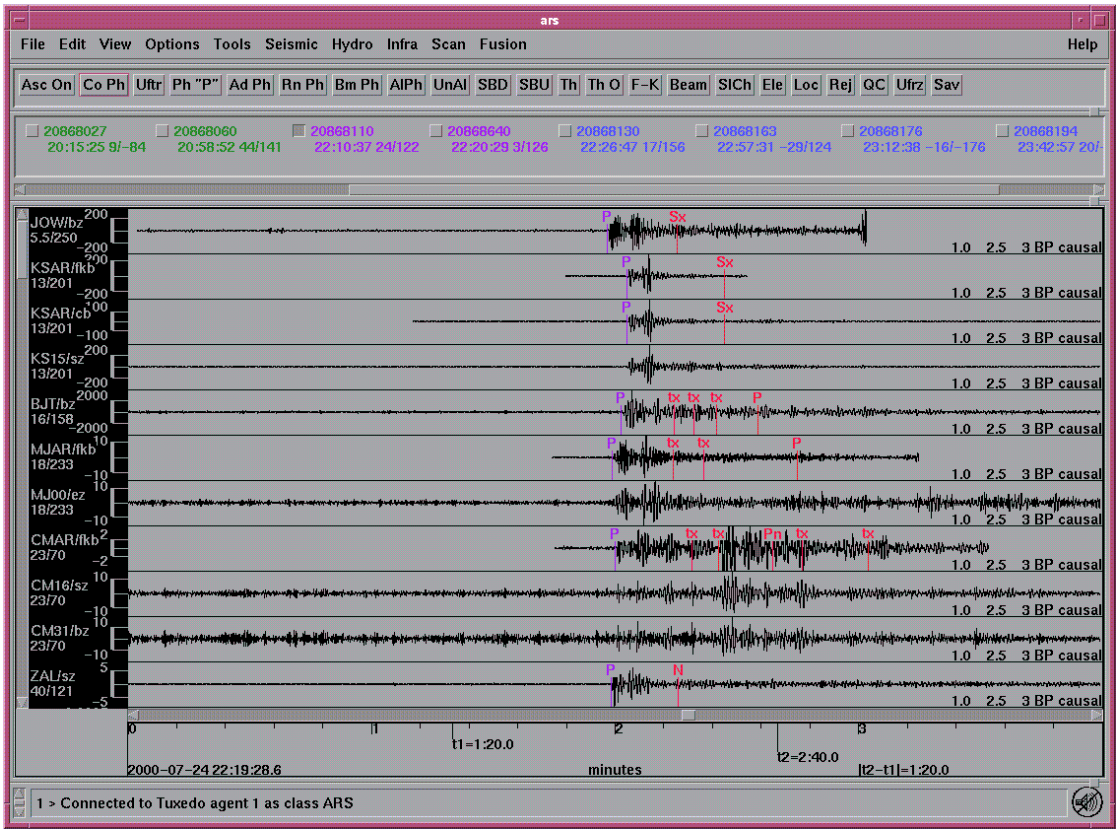

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav
20868027 20868060 20868110 20868640 20868130 20868163 20868176 20868194
JOW/bz 5.5/250
KSAR/fkb 13/201
KSAR/cb 13/201
KS15/sz 13/201
BJT/bz 16/158
MJAR/fkb 18/233
MJ00/ez 18/233
CMAR/fkb 23/70
CM16/sz 23/70
CM31/bz 23/70
ZAL/sz 40/121
1.0 2.5 3 BP causal
t1=1:20.0
t2=2:40.0
2000-07-24 22:19:28.6
minutes
|t2-t1|=1:20.0
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 58. ARS DISPLAY WITH ALL CHANNELS SELECTED

Edit > Select > Associated Arrivals

You may want to perform processing on all associated arrivals, for example, to send them all to *XfkDisplay*, display them in AlphaList, or plot them in *Map*. The Associated Arrivals menu option selects all arrivals associated with the selected event.

To select associated arrivals:

1. Select an event.

2. Choose Edit > Select > Associated Arrivals.

   All associated arrivals become highlighted in the waveform display, indicating that they have been selected.

3. Perform other operations on the selected arrivals.

Edit > Select > Select Associated Depth Phases

You may be required to calculate snrs on all associated time-defining depth phases. The Select Associated Depth Phases menu option selects all depth phases, which can then be run through *DFX* processing as a group. This option eliminates the risk of missing a depth phase. *ARS* recognizes pP, sP, pPKP, pPKPbc, pPKPab, and pPKiKP as depth phases.

To select associated depth phases:

1. Select an event.
2. Choose Edit > Select Associated Depth Phases.

   If depth phases are present they become highlighted in the waveform display, indicating that they have all been selected.

3. Apply other functions to the selected depth phases, typically *DFX* processing.

Edit > Rename

The Rename menu option renames single arrivals or groups of arrivals to any phase name defined in *ARS*. The Rename submenu items are shown in Figure 59.

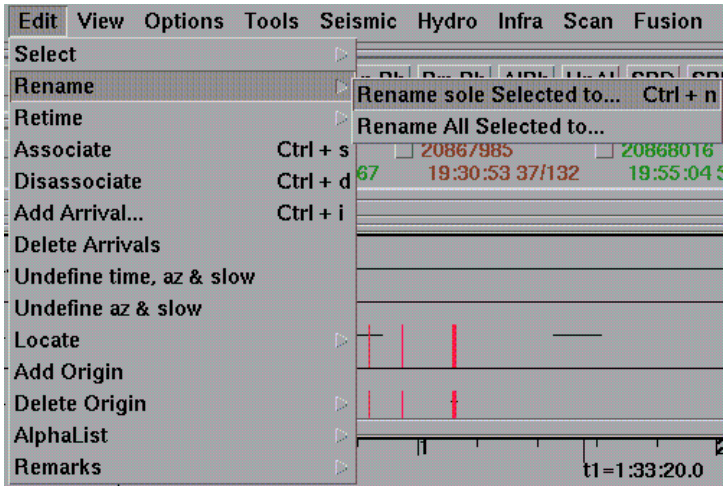
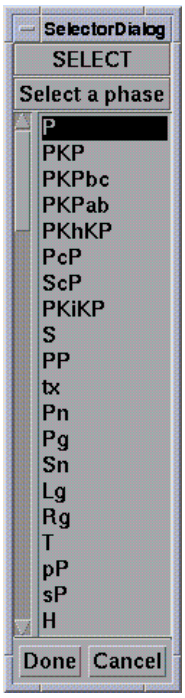


FIGURE 59. RENAME OPTIONS IN EDIT MENU

For both options listed under the Rename menu, *ARS* responds by displaying a list of phase names to choose from.

Edit > Rename > Rename sole Selected to…

The Rename sole Selected to… menu option renames one arrival. *ARS* provides the list of possible phase names. The arrival does not have to be associated to an event.



To rename a sole selected arrival:

1. Select one arrival.
2. Choose Edit > Rename > Rename sole Selected to…

   A phase list appears.
3. Select the desired phase name, then click Done (Figure 60).

   The arrival's phase name changes to that selected from the list. If a single event was selected the arrival automatically is associated to the event. If more than one event was selected, *ARS* displays a warning to select only one event.

FIGURE 60. PHASE LIST

Edit > Rename > Rename All Selected to…

The Rename All Selected to… menu option selects multiple arrivals and renames them all to a single phase name.

To rename all selected arrivals:

1. Select multiple arrivals by individually selecting them or by using one of the menu options for selection, such as Edit > Select > Select Associated Arrivals. To manually select multiple arrivals, press the Shift key while selecting multiple arrivals in sequence.
2. Choose Edit > Rename > Rename All Selected to…

   ARS displays a list of phase names.

3. Choose one of the phase names, then click Done.

   All selected arrivals' phase names will change to the name selected. If you selected an event, the arrivals automatically are associated to the event.

Edit > Retime

The Retime menu provides several submenu options related to retiming arrivals, as shown in Figure 61.

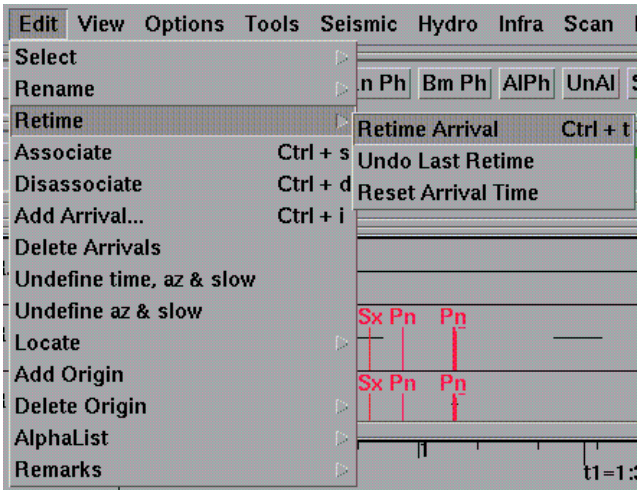


FIGURE 61. RETIME OPTIONS IN EDIT MENU

Edit > Retime > Retime Arrival

Retiming an arrival is primarily an *ARS* waveform window operation. The Retime Arrivals menu option retimes arrivals to fine tune their placement relative to the underlaying waveform feature they demarcate. *ARS* restricts the retiming of Automatic Processing detected arrivals to within four seconds of their SEL3-specified arrival time and provides an error message if you attempt to retime outside these bounds. Analyst-added arrivals are not subject to this restriction.

To retime an arrival:

1. Select the arrival to be retimed.

   An original arrival position might appear, as shown in Figure 62.

2. Use one of the following methods to position the t1 time marker to indicate the desired new arrival time:
   - Using the middle mouse button, click on the waveform at the desired location. This sets t1 to align with the waveform location selected. The t1 position and waveform appear, as in Figure 63.
   - Using the left mouse button, click on the t1 bar at the bottom of the *ARS* screen, and drag it to the desired location. A vertical line appears and extends from the t1 bar up through the waveform while you drag. The t1 position and waveform appear, as in Figure 64.

3. After placing t1, choose Edit > Retime > Retime Arrival.

   The arrival moves to the selected position, as shown in Figure 65.

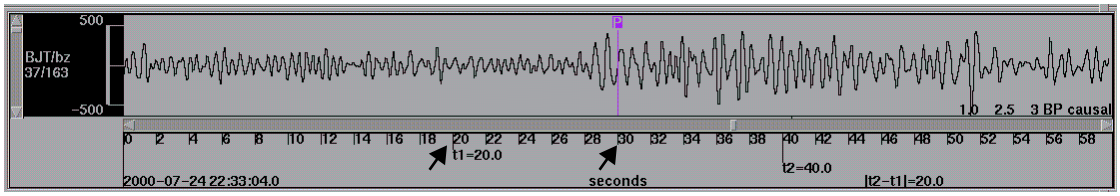


FIGURE 62. ARRIVAL'S ORIGINAL POSITION

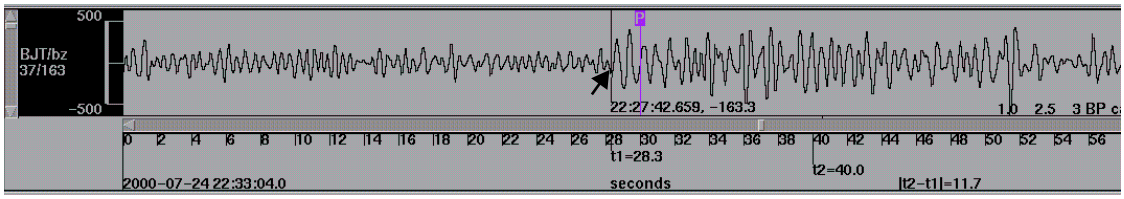


FIGURE 63. APPLY MIDDLE MOUSE BUTTON ON WAVEFORM

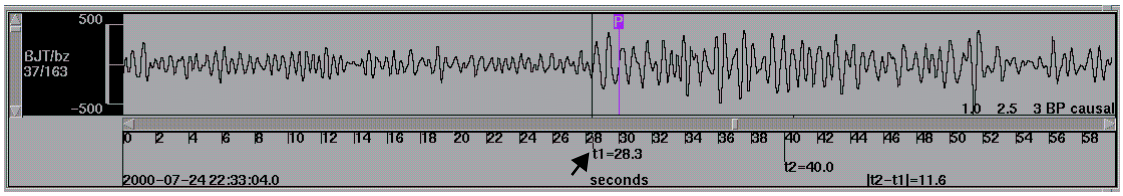


FIGURE 64. APPLY LEFT MOUSE BUTTON ON T1

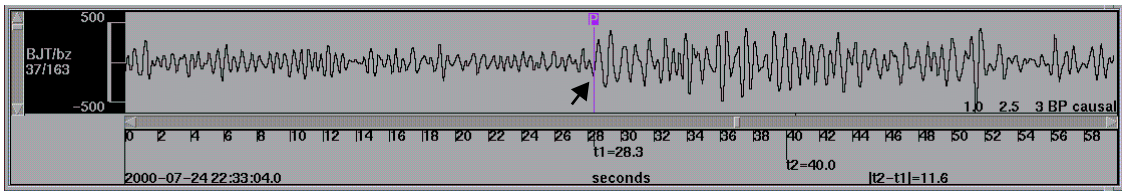


FIGURE 65. APPLY RETIME ARRIVAL

If the new position is more than four seconds from the original arrival position and the retiming restriction applies, *ARS* displays a warning in the message window as shown in Figure 66. You may add a new arrival if retiming requires positioning more than four seconds from the original arrival's original position.

FIGURE 66. MORE THAN 4 SECOND RETIME WARNING

Edit > Retime > Undo Last Retime

The Undo Last Retime menu option un-does your last retime action on an arrival. This option places the arrival in its previous position on the waveform. The options Retime Arrival, Undo Last Retime, and Reset Arrival Time all save a copy of the current arrival time before moving the arrival to the new time.

To undo the last retime action:

1. Select the most recently retimed arrival.
2. Choose Edit > Retime > Undo Last Retime.

   The arrival returns to its position immediately before the last retime action. This function applies only to the most recently retimed arrival and exchanges only the most recently saved arrival time. Applying Undo Last Retime successively toggles between the previous two retime positions.

Edit > Retime > Reset Arrival Time

The Reset Arrival Time menu option moves an arrival back to its original position (the arrival time specified in the SEL3 database).

To reset an arrival time:

1. Select an arrival.
2. Choose Edit > Retime > Reset Arrival Time.

   The arrival moves to its original position. This is the arrival's position in the waveform as determined by the Automatic Processing system.

Edit > Associate

The Associate menu option associates one or more arrivals to an event. Associating an arrival to an event indicates that the signal energy originated from the selected event and that the phase arrival time and measured characteristics should contribute to the event's location and magnitude solutions.

To associate an arrival(s) to an event:

1. Select an event.
2. Select one or more arrivals. To select multiple arrivals, press the Shift key while selecting additional arrivals one at a time.

3. Choose Edit > Associate.

   All selected arrivals become associated to the selected event. The event label and associated arrivals turn purple, indicating that the event has been modified.

Edit > Disassociate

The Disassociate menu option disassociates one or more arrivals from an event. You use disassociate after determining that an arrival did not originate from the selected event.

To disassociate an event:

1. Select an event.
2. Select one or more arrivals.
3. Choose Edit > Disassociate.

   The selected arrivals become disassociated from the selected event. The disassociated arrivals turn red, indicating they are no longer associated. The event label and remaining associated arrivals turn purple, indicating that the event has been modified.

Edit > Add Arrival...

The Add Arrival... menu option adds arrivals to a channel's waveform. If an event is selected, the arrival is associated with the event; otherwise it will be unassociated.

To add an arrival(s):

1. Select a channel. Optionally select an event.
2. Position t1 to indicate the new arrival's location. (Positioning t1 is described in "Edit > Retime > Retime Arrival" on page 82).
3. Choose Edit > Add Arrival...

   A popup phase name selection list appears.

4. Select the phase name, then click Done.

   An arrival of the selected phase type is added at the position of t1. If an event is selected, the arrival is associated and the event turns purple to indicate it has been modified. If no event is selected, the arrival appears in red, indicating it is unassociated.

Edit > Delete Arrivals

The Delete Arrivals menu option deletes one arrival at a time. This option is most useful for deleting incorrectly added arrivals. You generally do not delete Automatic Processing created arrivals, because it is usually sufficient just to disassociate them. Deleted SEL3 arrivals are not removed from the database; they are simply removed from the current *ARS* display. If you were to load the same *ARS* session again, you would see the arrival reappear.

To delete arrivals:

1. Select a single arrival. The arrival does not have to be associated to an event.
2. Choose Edit > Delete Arrivals…

   The arrival disappears from the screen.

ARS provides a warning if you try to delete more than one arrival at a time.

Edit > Undefine time, az & slow

Time, azimuth, and slowness are arrival parameters that can contribute to an event's location solution. The Undefine time, az & slow menu option makes time, azimuth, and slowness undefining for all arrivals associated to an event. Undefining means that the parameters do not contribute to the event location computation.

To make time, azimuth, and slowness undefining:

1. Select an event.

2. Choose Edit > Undefine time, az & slow.

   By displaying AlphaList, you can observe that the time, azimuth, and slowness parameters for all phases are labelled n, for non-defining. This indicates that these arrival parameters will not be contributing to the event location.

Slowness is considered unreliable for Infrasonic data and is not normally used. T-phases often have unreliable time, azimuth, and slowness owing to the uncertainty of their travel path.

Edit > Undefine az & slow

Time, azimuth, and slowness are arrival parameters that can contribute to an event's location solution. The Undefine az & slow menu option makes all associated arrivals' azimuth and slowness parameters undefining, but leaves the time parameters defining. Because arrival time is often the most reliably measured parameter, you may wish to prevent only the less reliable azimuth and slowness parameters from contributing to an event's location solution. For large seismic events with many arrivals, you should use time as the sole defining parameter for each arrival.

To make azimuth and slowness undefining:

1. Select an event. Select Undefine az & slow.

   Azimuth and slowness become undefining parameters for all arrivals, meaning that they will not contribute in the event location solution. Time is kept as the sole defining parameter. Figure 67 shows an AlphaList display after Undefine az & slow has been applied, leaving only arrival time parameters defining.

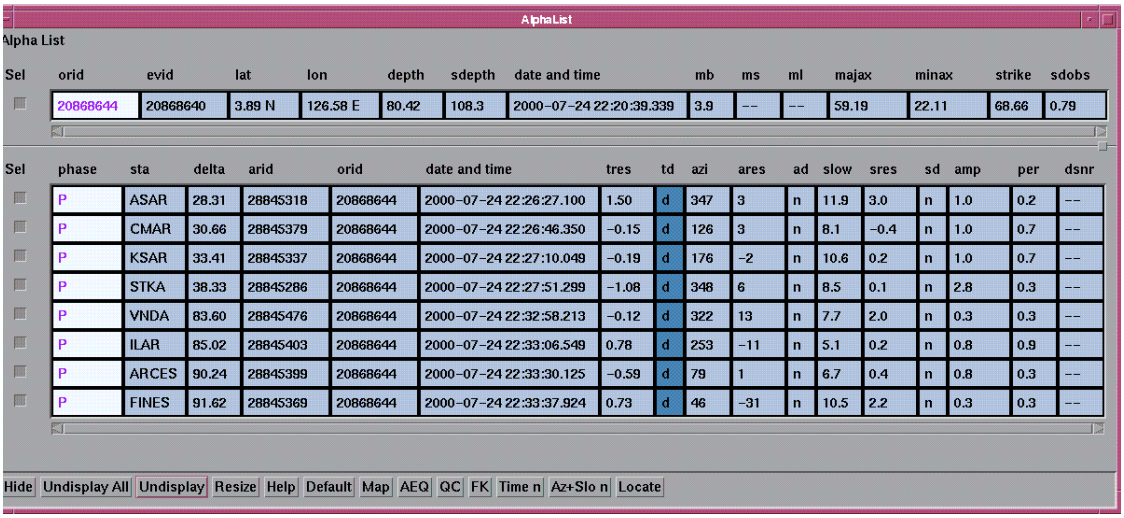


FIGURE 67. ALPHALIST AFTER APPLYING UNDEFINE AZ & SLOW

Edit > Locate

The Locate menu contains two submenu options, as shown in Figure 68.

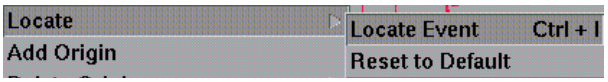


FIGURE 68. EDIT > LOCATE SUBMENU

Edit > Locate > Locate Event

The Locate Event menu option recomputes the location solution of the selected event. This option also appears as tool buttons labeled `Loc` or `Locate` in various places in the *ARS* display. Because accurate locations are an important goal, you may locate an event many times during the course of analysis, often after each sequence of modifications.

To locate an event:

1. Select an event. If desired, perform analysis to refine the event.
2. Choose Edit > Locate Event.

   The location of the event is calculated, and the updated event information is displayed in the Locator dialogue box (Figure 42 on page 59), the Magnitude dialogue box (Figure 44 on page 61), AlphaList (Figure 69), and in the event label presented in the event scroll bar at the top of the *ARS* display. Also, the theoretical arrival times are adjusted to reflect the new location.

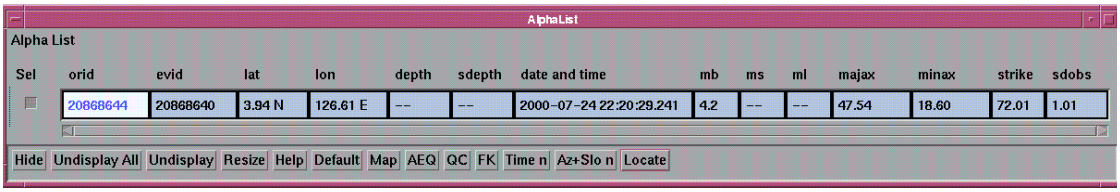


FIGURE 69. ALPHALIST AFTER LOCATING

Edit > Locate > Reset to Default

The Reset to Default menu option resets the location of an event to an invalid location of 999.00 S, 999.00 W, and no depth, as shown in Figure 70. This option may be useful for scanning where a preset location is not desirable. Or if you think *ARS* is not computing an accurate location solution, but is hanging on a local computation minimum rather than a global computation minimum, you can reset the location and attempt to relocate. This situation is sometimes encountered during depth phase analysis.

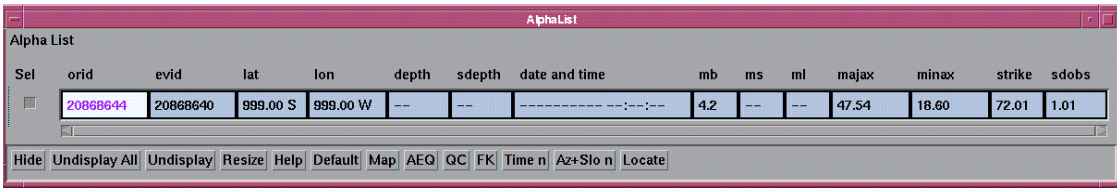

AlphaList
Alpha List
Sel orid evid lat lon depth sdepth date and time mb ms ml majax minax strike sdobs
20868644 20868640 999.00 S 999.00 W -- -- ---------- --:--:-- 4.2 -- -- 47.54 18.60 72.01 1.01
Hide Undisplay All Undisplay Resize Help Default Map AEQ QC FK Time n Az+Slo n Locate

FIGURE 70. ALPHALIST SHOWING DEFAULT LOCATION

After resetting the location, you may choose the Locate Event option immediately to compute a new location, or you may choose to refine the event before locating. When *ARS* has sufficient information it can successfully compute a new location.

To reset the event location to the default:

1. Select an event.
2. Choose Reset to Default.

   The location for this event is reset to 999.00 S, 999.00 W, and no depth.

Edit > Add Origin

The Add Origin menu option creates a new event. The new event initially has no origin time, location, or associated phases. You can add phases and locate the event in a similar manner to other events under analysis. You use Add Origin when you want to add an event to those events created by the Automatic Processing software. This may occur for the following reasons, including mixed events, scanning, or experimentation:

- You discover that arrivals originating from two or more events have been associated to a single event. You need to create one or more new events to receive the arrivals not belonging to the original. You can then analyze and independently locate each event.

- Scanning is a process where you scroll through the waveform data looking for events missed by Automatic Processing. During scanning you create new events and associate added or previously unassociated arrivals to build a new event. You then refine and locate the new event in the standard manner.
- In a non-operational or experimental analysis session it is convenient to save separate arrivals if they are associated to an event. You or the researcher may wish to group interesting phases for study or create an alternate origin hypothesis by associating to a new origin and saving the event. This should be done with caution and saved to a non-operational database account.

To create a new event:

1. Choose Edit > Add Origin.

   A new origin appears at the end of the event scroll bar at the top of the *ARS* display. This event initially has a negative *evid* and no location or associated arrivals.

Edit > Delete Origin

ARS provides two submenu options to delete events, as shown in Figure 71. You may occasionally need to delete an origin. Similar to the option Delete Arrivals, The Delete Origin menu option removes the event from the display and does not affect the databases. It is equivalent to leaving origins unsaved and undiscarded.

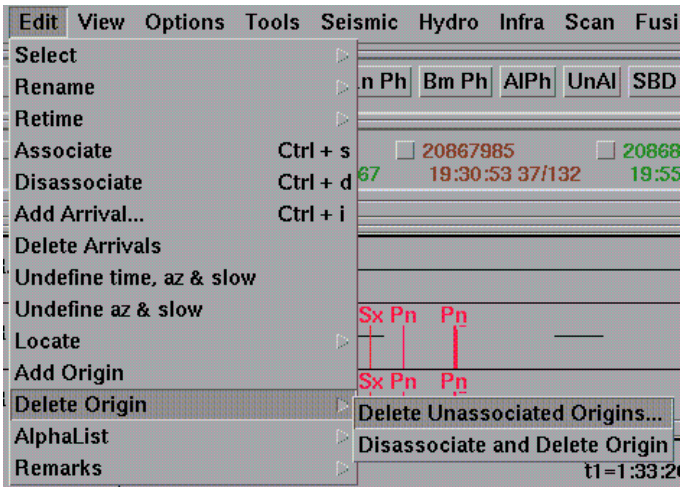


FIGURE 71. DELETE ORIGIN SUBMENU

Edit > Delete Origin > Delete Unassociated Origins…

The Delete Unassociated Origins… menu option deletes one or more events that have no associated arrivals.

To delete unassociated arrivals:

1. Select one or more events.
2. Choose Edit > Delete Origin > Delete Unassociated Origins…

   ARS presents a confirmation window with a list of the currently selected events, as shown in Figure 72. Initially, all events are selected, but you can unselect or select individual events.

FIGURE 72. DELETE ORIGIN VERIFICATION MESSAGE

3. Verify that you are deleting the correct origin, then click Done.

   The event(s) disappear from the scroll bar. If arrivals are still associated to an event when you click Done, *ARS* does not delete the event and instead issues a warning, as shown in Figure 73.

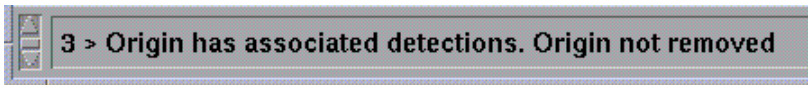


FIGURE 73. ARS WARNING FOR ATTEMPTING TO DELETE EVENT WITH ASSOCIATED PHASES

Edit > Delete Origin > Disassociate and Delete Origin

The Disassociate and Delete Origin menu option allows you to delete an origin without first disassociating its arrivals.

Caution: THIS OPTION DOES NOT PROVIDE ANY VERIFICATION WINDOW AND ACTS IMMEDIATELY.

To disassociate and delete an origin:

1. Select an event.

2. Choose Edit > Delete Origin > Disassociate and Delete Origin.

   ARS automatically disassociates the phases and deletes the origin from the event scroll bar at the top of the *ARS* screen. *ARS* does not prompt you to confirm the deletion.

Edit > AlphaList

AlphaList menu option displays event, arrival, and station data in a tabular format. You may need to access AlphaList often during analysis. For a complete description of AlphaList window see "AlphaList" on page 180. AlphaList option provides two submenu options for accessing AlphaList, as shown in Figure 74.

FIGURE 74. ALPHALIST DISPLAY OPTIONS

Edit > AlphaList > Show with Selected...

The Show with Selected… menu option displays AlphaList with all selected events, arrivals, and stations. By selecting or unselecting objects in the main *ARS* window, you control what is displayed in AlphaList.

To display AlphaList with selected events, arrivals, and stations:

1. Select an event.
2. Select one or more arrivals to be displayed with AlphaList.
3. Select a station if desired.
4. If no arrivals or stations are desired, deselect all arrivals and stations by clicking on an empty space in the waveform display.
5. Choose Edit > AlphaList > Show with Selected…

   AlphaList window, with the selected event and any selected arrivals or stations, is displayed in front of the *ARS* waveform display.

Edit > AlphaList > Show with Associated…

You often may use AlphaList to look at the information related to an event. The Show with Associated… menu option displays AlphaList and all arrivals associated to any selected events, whether selected or not. All other selected objects are also displayed.

1. Select an event.
2. Choose Edit > AlphaList > Show with Associated…

   AlphaList window, with all phases associated to the selected event, is displayed in front of the *ARS* waveform display.

Edit > Remarks

You can add remarks to events or arrivals for annotation or clarification. The Remarks submenu provides a number of options for using remarks, as shown in Figure 75.

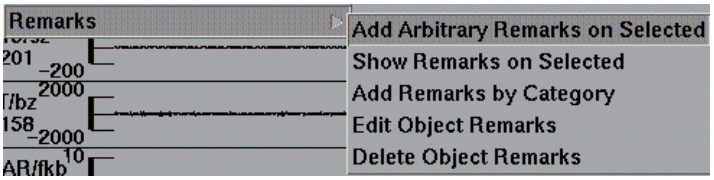


FIGURE 75. REMARKS SUBMENU

When remarks are added to an event, the letter R appears beside the event label, as shown in Figure 76. If the comment is deleted, the R is removed. Added remarks appear with the event in the REB.

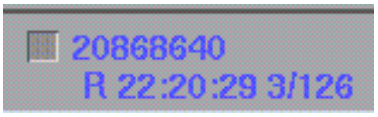


FIGURE 76. EVENT WITH REMARKS

Edit > Remarks > Add Arbitrary Remarks on Selected

If the list of standard remarks provided under the Add Remarks by Category menu option is insufficient, you can choose the Add Arbitrary Remarks on Selected menu option to type an arbitrary remark.

To add arbitrary remarks on selected events:

1. Select and analyze an event.
2. If the event requires a non-standard remark, choose Edit > Remarks > Add Arbitrary Remarks on Selected.

   A text editing box with a cursor appears, as shown in Figure 77. Enter a non-standard comment, then select Done.

Caution: BE CAREFUL TO HAVE ONLY ONE OBJECT SELECTED WHEN ADDING A REMARK. IF YOU SELECT ARRIVALS WITH THE EVENT, THE REMARK IS ATTACHED TO EACH OF THE SELECTED ARRIVALS. IF THE REMARK WAS INTENDED TO APPLY ONLY TO A CERTAIN ARRIVAL, DE-SELECT THE EVENT AS WELL AS ALL OTHER ARRIVALS. (TO DESELECT AN EVENT, PRESS THE SHIFT KEY WHILE CLICKING ON THE EVENT.) GENERALLY, IF OTHER OBJECTS ARE SELECTED WHILE YOU ARE ADDING REMARKS, THE REMARK IS ATTACHED TO EACH OF THESE OBJECTS.

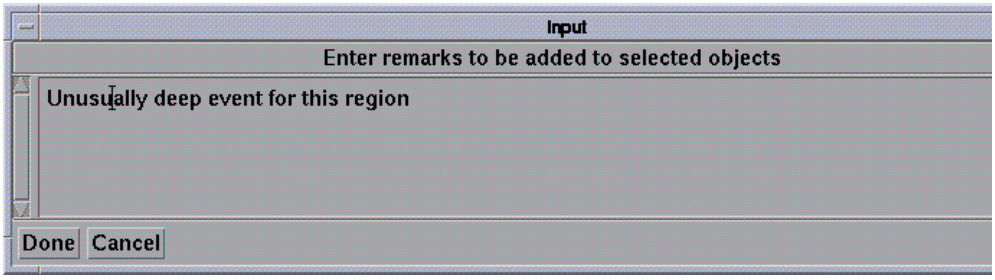


FIGURE 77. TEXT EDITING BOX FOR NON-STANDARD REMARKS

Edit > Remarks > Show Remarks on Selected

The Show Remarks on Selected menu option displays the added remarks. An example remarks window is shown in Figure 78.

To show remarks on selected events:

1. Select an event.
2. Choose Edit > Remarks > Show Remarks on Selected.

   A list of all associated arrivals and the origin identifier is displayed with any remarks appearing directly under the relevant object(s). If only one arrival is selected, only remarks for that arrival are displayed.

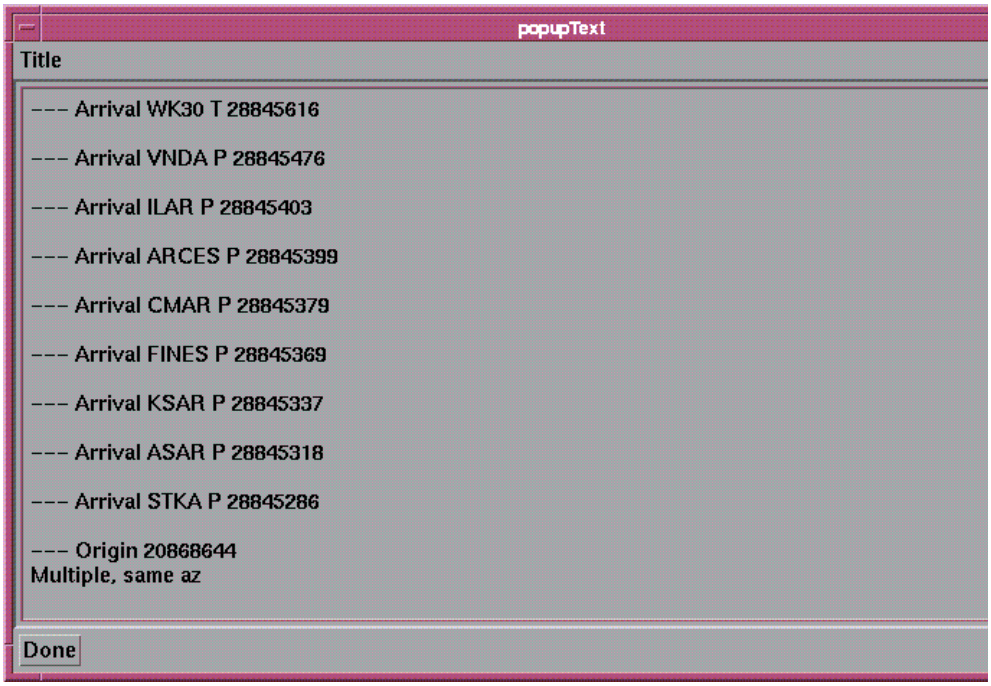


FIGURE 78. REMARK ON AN EVENT

Edit > Remarks > Add Remarks by Category

The Add Remarks by Category menu option displays a list of standard remark categories from which you typically can find an appropriate annotation.

To add remarks by category:

1. Select and analyze an event.
2. If the event requires a standard remark, choose Edit > Remarks > Add Remarks by Category.

   A list of remark categories appears as shown in Figure 79.

FIGURE 79. REMARK CATEGORIES

3. From the list, select `Event, static remark`.

   A list of static remarks appears, as shown in the left selection window in Figure 80.

4. Select a remark from the list, then click Done.

   After a remark has been attached to an event, an `R` appears with the event in the event scroll bar at the top of the *ARS* window.

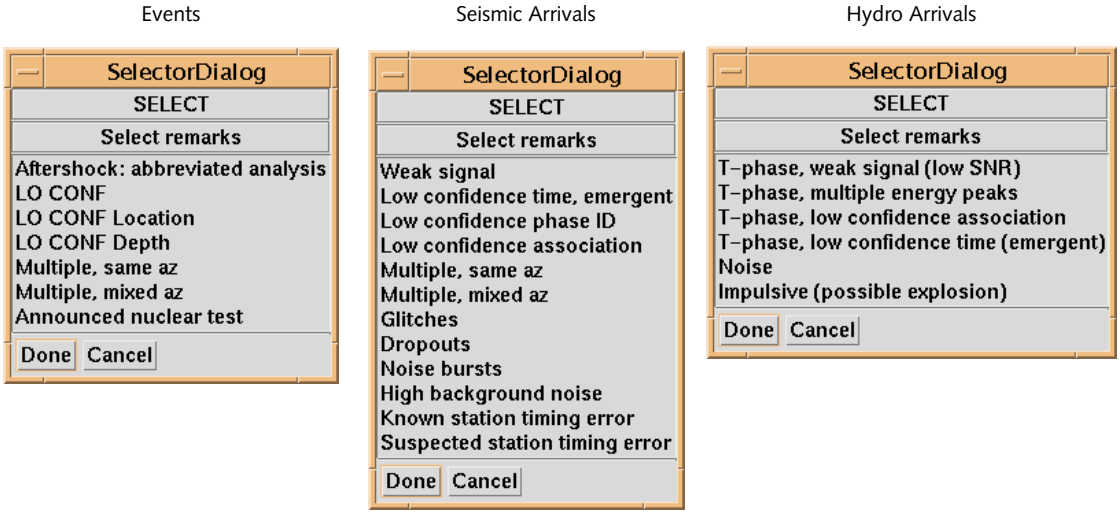


FIGURE 80. STATIC REMARKS SELECTION DIALOGUE BOXES

Figure 80 also shows the static remarks available for seismic and hydroacoustic arrivals. Adding remarks to an arrival is similar in procedure to adding a remark to an event. Be careful to have only the intended arrival and no other arrivals or events selected or they will also receive the remark.

Edit > Remarks > Edit Object Remarks

The Edit Object Remarks menu option is used to edit or delete an arrival or event's remarks.

To edit object remarks:

1. Select an event with a remark attached to it.
2. Choose Edit > Remarks > Edit Object Remarks.

   A text editing box containing the current remark appears.
3. Edit the remark, then click Done. If the remark text is cleared (completely blank) when you click Done, the remark is effectively deleted and the R is removed from the event's label.

Edit > Remarks > Delete Object Remarks

If changes have been made to an event or arrival, an added remark may no longer apply. You can delete the remark using the Delete Object Remarks menu option.

To delete object remarks:

1. Select the single object that the remark is attached to. For example, if the remark was added to an event, you must select only the event.
2. Choose Edit > Remarks > Delete Object Remarks.

   The remark is deleted. For events, the R that appears with the event in the event scroll bar at the top of the *ARS* window disappears.

View Menu

The View menu, as shown in Figure 81, provides options for modifying the waveform display by aligning, filtering, displaying theoretical arrivals, changing which channels are visible, and zooming and scrolling the waveform time window.

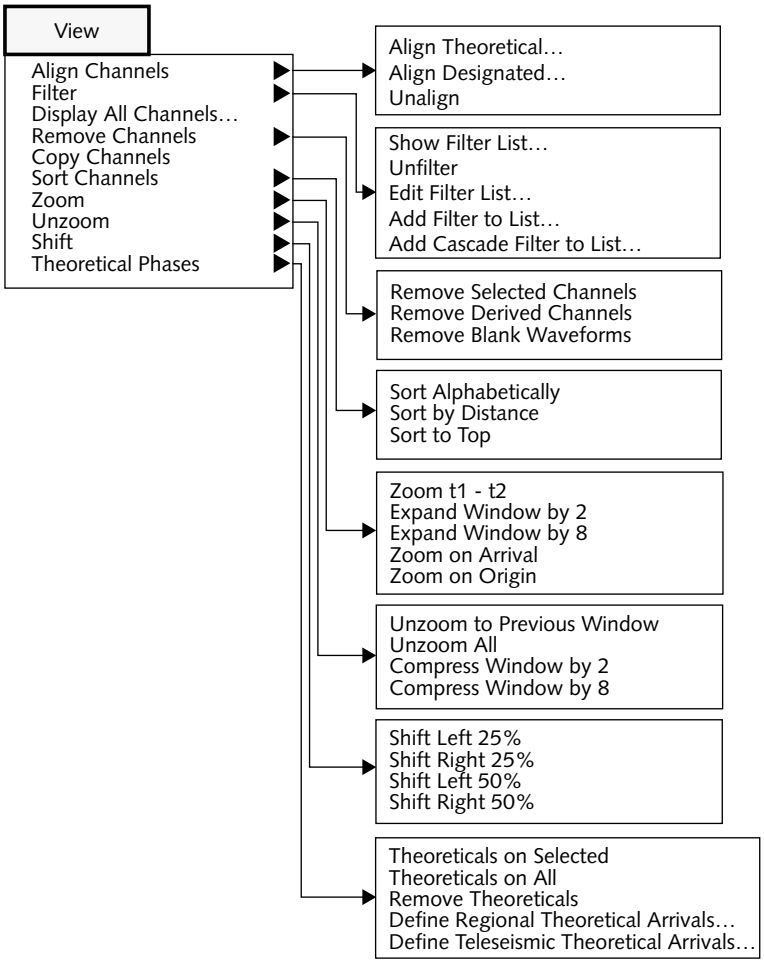


FIGURE 81. ARS VIEW MENU

View > Align Channels

The Align Channels submenu provides the alignment options shown in Figure 82.

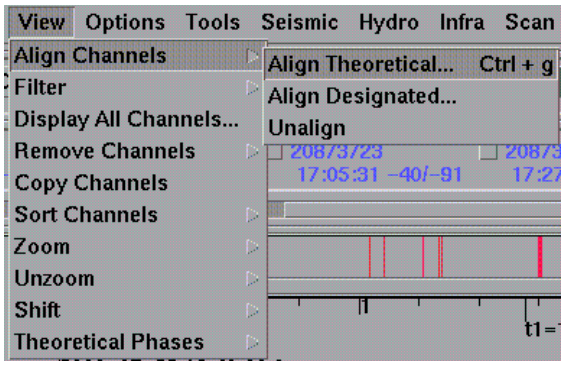


FIGURE 82. ALIGN SUBMENU UNDER VIEW MENU

View > Align Channels > Align Theoretical...

You can align the waveforms on the theoretical arrival time of a selected phase. The theoretical arrival time is based on the current event location.

To align waveforms on theoretical arrival time:

1. Select an event.
2. Choose View > Align Channels > Align Theoretical…

   A phase selection list appears.
3. Select the phase on which to align, then click Done.

   The waveforms realign on the theoretical arrival time of the selected phase. The theoretical arrival time is positioned in the middle of the *ARS* screen. Figure 83 shows waveforms aligned on theoretical P with the theoretical arrival times shown in yellow. The actual P arrivals often do not align with the theoretical because of differences between actual travel times and travel times calculated from earth models, because of measurement error, or because of location error.

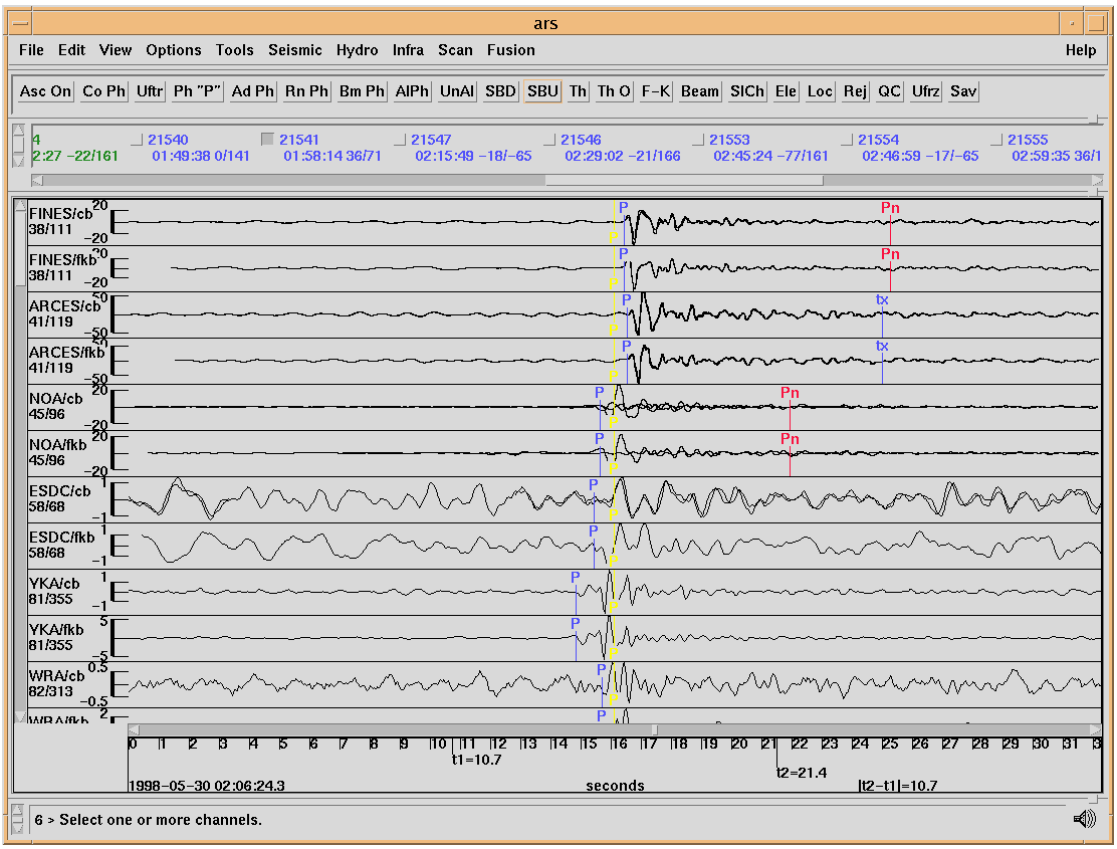


FIGURE 83. WAVEFORMS ALIGNED ON THEORETICAL P PHASE

View > Align Channels > Align Designated...

You can display the waveforms aligned on associated phases. When applied, the Align Designated... menu option realigns the waveforms so that the associated arrivals of the same phase are aligned vertically. Figure 84 shows waveforms that have been aligned on associated P phases. This option aligns on actual arrival time.

To align associated phases:

1. Select event.

2. Choose View > Align Channels > Align Designated…

   A phase list appears.

3. Select the phase on which the waveforms should align, then click Done in the phase list window.

   The waveforms are time shifted to realign the chosen phase vertically in the middle of the *ARS* screen.

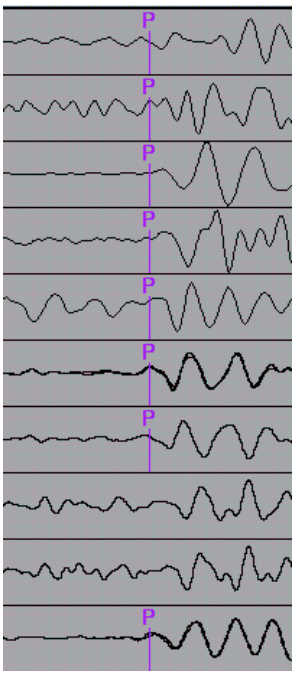


FIGURE 84. VIEW > ALIGN DESIGNATED...

View > Align Channels > Unalign

The Unalign menu option resets the waveform alignment of all channels to the same absolute time or measurement time. Therefore, you can use the middle mouse button to display time on individual waveforms and the same horizontal

location will show the same absolute time across all channels. Aligning channels on absolute time is particularly useful for scanning. The option is referred to as Unalign because waveform alignment is not relative to a specific event or phase.

To unalign channels:

1. Choose View > Align Channels > Unalign. It is not necessary to select an event.

   The waveforms align based on time of measurement.

View > Filter

Filtering is a technique commonly used for enhancing waveform signal to noise. While filtering can improve the appearance of waveform features, it can also introduce signal distortion. Filtering and other signal enhancement techniques are discussed further in "Techniques" sections in both [IDC5.2.1] and [IDC6.5.2Rev0.1]. The Filter submenu provides several display options as shown in Figure 85.

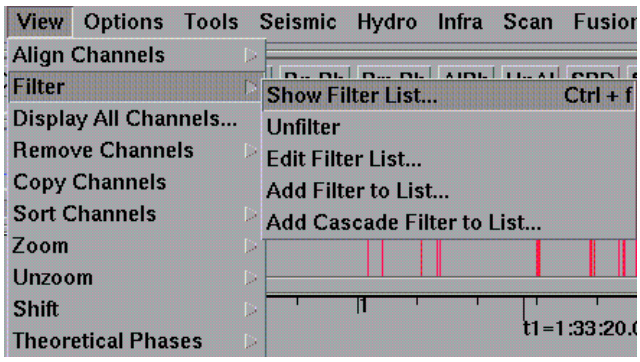


FIGURE 85. FILTER OPTIONS UNDER VIEW MENU

View > Filter > Show Filter List…

The Show Filter List… menu option displays a selection window with a list of available filters (Figure 86). The filter list window remains displayed until you intentionally close it. The window is displayed on the right-hand screen.

The list contains the filters most commonly used to enhance waveform appearance. The filters in the default list are all band pass filters, with the exception of one band rejection filter. The filter list is organized by technology. Filters commonly applied to hydroacoustic signals are at the top of the list, seismic filters are in the middle of the list, and infrasound filters are at the bottom of the list. Typically, hydroacoustic signals are seen at higher band pass frequencies than the other time-series technologies. Infrasonic signals are typically best seen at lower band pass frequencies.

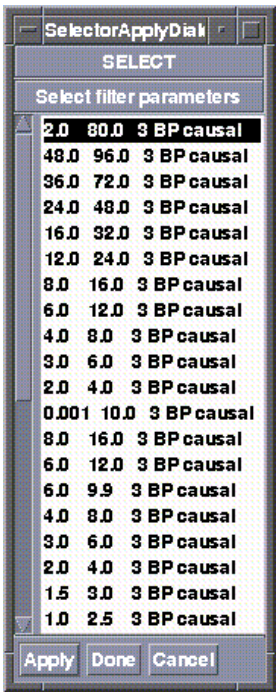

SelectorApplyDial
SELECT
Select filter parameters
2.0 80.0 3 BP causal
48.0 96.0 3 BP causal
36.0 72.0 3 BP causal
24.0 48.0 3 BP causal
16.0 32.0 3 BP causal
12.0 24.0 3 BP causal
8.0 16.0 3 BP causal
6.0 12.0 3 BP causal
4.0 8.0 3 BP causal
3.0 6.0 3 BP causal
2.0 4.0 3 BP causal
0.001 10.0 3 BP causal
8.0 16.0 3 BP causal
6.0 12.0 3 BP causal
6.0 9.9 3 BP causal
4.0 8.0 3 BP causal
3.0 6.0 3 BP causal
2.0 4.0 3 BP causal
1.5 3.0 3 BP causal
1.0 2.5 3 BP causal
Apply
Done
Cancel

FIGURE 86. ARS FILTER LIST

After the filter list is displayed, you can use it for the rest of that *ARS* session.

To show the filter list:

1. Select a channel. You must have one or more channels selected to initially display the filter list.

2. Choose View > Filter > Show Filter List…

   The filter list appears. Only a portion of the available filters is visible. A scroll bar gives access to the remainder.

3. To apply a filter, either select the filter and then click Apply, or double-click on the desired filter.

4. To see which filter is currently applied to a waveform, check the label toward the right edge of the waveform display in *ARS*.

   In Figure 87, `1.0 2.5 3 BP causal` represents a 1–2.5 Hz third-order band pass causal filter.

5. To close the window, either click Done to apply the selected filter or click Cancel to not apply it.

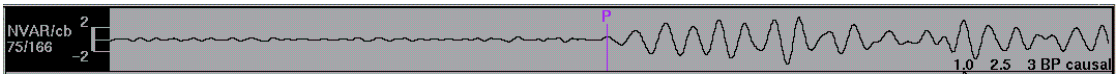


FIGURE 87. WAVEFORM WITH FILTER STATUS

View > Filter > Unfilter

The Unfilter menu option unfilters the waveform data, which means it displays it in its raw waveform state, without a filter applied to it.

To unfilter waveforms:

1. Select a filtered channel.
2. Choose View > Filter > Unfilter.

   The channel's filter is removed from the waveform data.

View > Filter > Edit Filter List…

The Edit Filter List… menu option allows you to edit the characteristics of individual filters in the filter list. You can change the frequency limits, filter order, or filter type.

To edit the filter list:

1. Choose View > Filter > Edit Filter List… You need not select a channel or display the filter list.

   ARS presents a selection box with a list of available filters.

2. Select the filter to be edited.

   ARS displays a filter editing dialogue box, as shown in Figure 88.

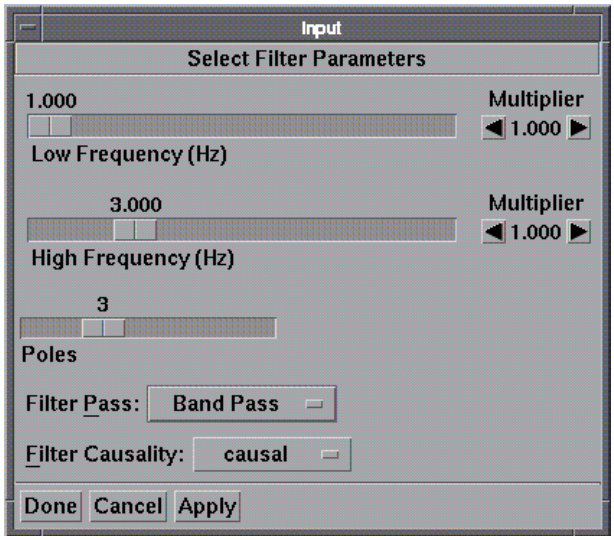


FIGURE 88. FILTER EDITING DIALOGUE BOX

The filter editing dialogue box provides controls for setting all filter parameters:

- Set high and low frequency bounds by using the slider bars and multiplier settings. Use the multiplier to set the power of 10, then use the slider to adjust the frequency value. The frequency value shown above the slider bar reflects the effect of the multiplier setting and the slider bar position.

  Slider bars respond to several types of actions:

  – Click and drag the slider to desired values.
  – Left-click on either side of the slider to jump by increments of 10.

  - Middle-click on either side of the slider to position the slider at the clicked position.
  - Use the right and left-arrow keyboard keys to increment or decrement the least significant digit in the filter value for very fine tuning.

- The filter order or number of poles determine the steepness of the flanks of the passband. Use the Poles slider to set up to an eighth order filter. Use the option button to control the type of filter. The choices are band pass, low pass, high pass, and band reject filter, as shown in Figure 89.
- The Filter Causality button provides the choice between causal and non-causal filter.

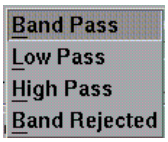


FIGURE 89. FILTER TYPES

3. When you have set all parameters, click Done.

   The edited filter is then available for use.

If the filter list is displayed at the time you edit the individual filters, you must undisplay the filter list and redisplay it for the edits to take effect. To undisplay the list and then redisplay it, click Done or Cancel on the filter list, then choose View > Filter > Show Filter List…

View > Filter > Add Filter to List...

The Add Filter to List... menu option creates a non-standard filter and adds it to the default filter list.

To add a filter to the default filter list:

1. Choose View > Filter > Add Filter to List... You need not select a channel. The filter list should not be displayed.
2. A filter editing dialogue box appears, as shown in Figure 88. This filter editing dialogue box is described in "View > Filter > Edit Filter List..." on page 108.
3. When all parameters are set to their desired values, click Done.
4. Choose View Filter > Show Filter List... to redisplay the filter list and access the new filter.

View > Filter > Add Cascade Filter to List...

This option creates a cascade filter, meaning that each filter in a specific list can be applied in sequence to a selected waveform.

To add a cascade filter to the list:

1. Choose View > Filter > Add Cascade Filter to List... You need not select a station or channel, or display the filter.

   ARS displays the default filter list.
2. Select one filter to add on to, to create a cascade or sequence filter.

   A screen is displayed with options to add a filter. This screen is identical to the one described in "View > Filter > Edit Filter List..." on page 108.
3. Select options for an additional filter, then click Done in the edit window.

   A cascade filter, comprised of the original filter and the added filter, is created. Each filter is applied in sequence to the selected waveform.

View > Display All Channels...

The Display All Channels... menu option displays a selection dialogue box that lists all channels available for display in *ARS*. This option is most often used to add channels not already displayed. The list of available channels is created from the network parameter specified in the File>Read dialogue box. The default network parameter is placed in the `ARS.load` file by the *ARSscan* application at the request of the *analyst_log* application. *ARSscan* also creates an optimized list of display channels and places these in `ARS.load`. *ARS* uses this list as its default display list, both ensuring complete channel coverage for the current *ARS* session and relieving you from needing to frequently select display channels from the full list.

1. Choose View > Display All Channels... You need not select an event or channel.

   A channel selection dialogue containing a scrolling list of available channels and a list of available stations is displayed, as shown in Figure 90. Currently displayed stations and channels are already selected, so selecting additional channels adds to those currently displayed.

2. To display additional channels, first select the station from the mid-part of the dialogue box. You can select multiple stations.

3. Select the individual channel elements in the top part of the display. You can select multiple elements. The bottom of the dialogue box contains buttons that expedite the selection and de-selection process. Click Done when finished.

   The selected channels are displayed in *ARS*. If you select a station, but do not select any of its associated channel elements, nothing from that station is displayed.

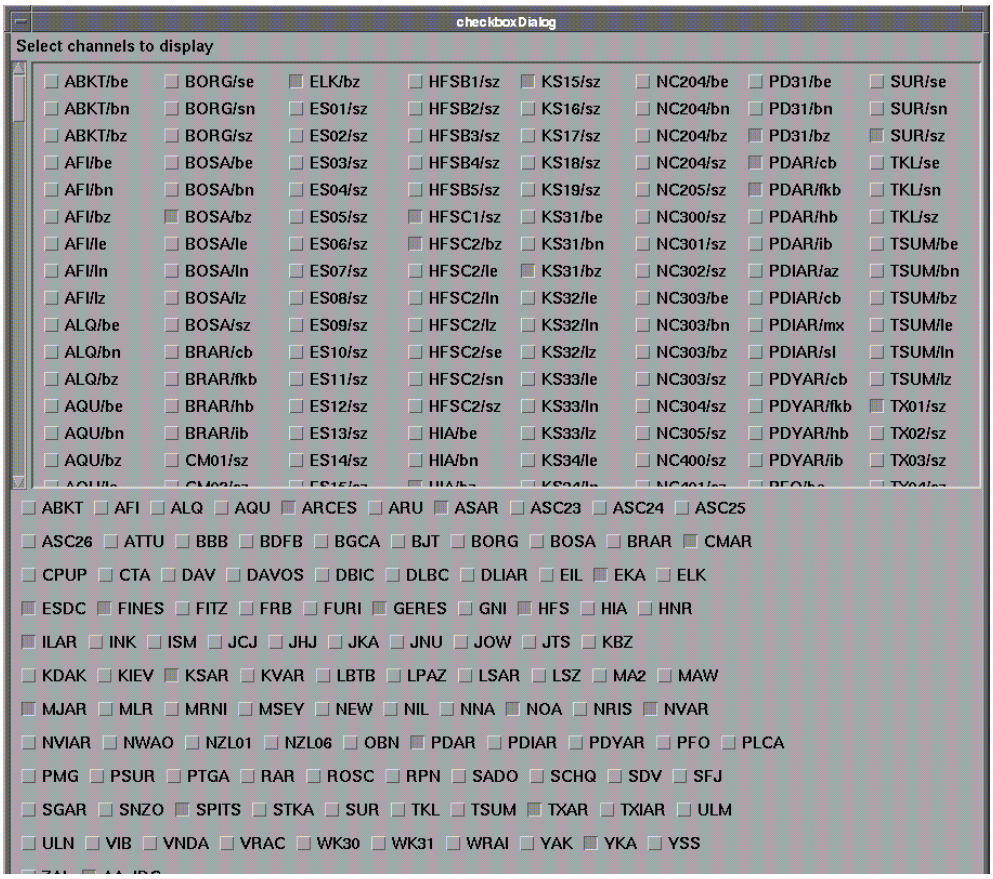

checkbox Dialog
Select channels to display
ABKT/be BORG/se ELK/bz HFSB1/sz KS15/sz NC204/be PD31/be SUR/se
ABKT/bn BORG/sn ES01/sz HFSB2/sz KS16/sz NC204/bn PD31/bn SUR/sn
ABKT/bz BORG/sz ES02/sz HFSB3/sz KS17/sz NC204/bz PD31/bz SUR/sz
AFI/be BOSA/be ES03/sz HFSB4/sz KS18/sz NC204/sz PDAR/cb TKL/se
AFI/bn BOSA/bn ES04/sz HFSB5/sz KS19/sz NC205/sz PDAR/fkb TKL/sn
AFI/bz BOSA/bz ES05/sz HFSC1/sz KS31/be NC300/sz PDAR/hb TKL/sz
AFI/le BOSA/le ES06/sz HFSC2/bz KS31/bn NC301/sz PDAR/ib TSUM/be
AFI/ln BOSA/ln ES07/sz HFSC2/le KS31/bz NC302/sz PDIAR/az TSUM/bn
AFI/lz BOSA/lz ES08/sz HFSC2/ln KS32/le NC303/be PDIAR/cb TSUM/bz
ALQ/be BOSA/sz ES09/sz HFSC2/lz KS32/ln NC303/bn PDIAR/mx TSUM/le
ALQ/bn BRAR/cb ES10/sz HFSC2/se KS32/lz NC303/bz PDIAR/sl TSUM/ln
ALQ/bz BRAR/fkb ES11/sz HFSC2/sn KS33/le NC303/sz PDYAR/cb TSUM/lz
AQU/be BRAR/hb ES12/sz HFSC2/sz KS33/ln NC304/sz PDYAR/fkb TX01/sz
AQU/bn BRAR/ib ES13/sz HIA/be KS33/lz NC305/sz PDYAR/hb TX02/sz
AQU/bz CM01/sz ES14/sz HIA/bn KS34/le NC400/sz PDYAR/ib TX03/sz
ABKT AFI ALQ AQU ARCES ARU ASAR ASC23 ASC24 ASC25
ASC26 ATTU BBB BDFB BGCA BJT BORG BOSA BRAR CMAR
CPUP CTA DAV DAVOS DBIC DLBC DLIAR EIL EKA ELK
ESDC FINES FITZ FRB FURI GERES GNI HFS HIA HNR
ILAR INK ISM JCJ JHJ JKA JNU JOW JTS KBZ
KDAK KIEV KSAR KVAR LBTB LPAZ LSAR LSZ MA2 MAW
MJAR MLR MRNI MSEY NEW NIL NNA NOA NRIS NVAR
NVIAR NWAO NZL01 NZL06 OBN PDAR PDIAR PDYAR PFO PLCA
PMG PSUR PTGA RAR ROSC RPN SADO SCHQ SDV SFJ
SGAR SNZO SPITS STKA SUR TKL TSUM TXAR TXIAR ULM
ULN VIB VNDA VRAC WK30 WK31 WRAI YAK YKA YSS

FIGURE 90. LIST OF CHANNELS

View > Remove Channels

The Remove Channels submenu provides options for removing channels from the current *ARS* display, as shown in Figure 90. These options are typically applied to remove excess clutter from the display. Removing channels does not prevent *ARS* from redisplaying them using Display All Channels…

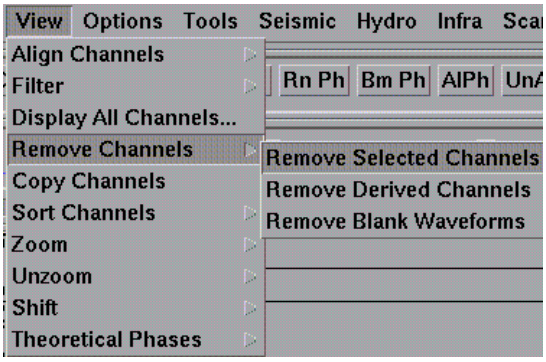


FIGURE 91. REMOVE CHANNELS SUBMENU

View > Remove Channels > Remove Selected Channels

The Remove Selected Channels menu option removes one or more selected channels.

To remove selected channels:

1. Select one or more channels to be removed.
2. Choose View > Remove Channels > Remove Selected Channels.

   The selected channels disappear from the *ARS* display.

View > Remove Channels > Remove Derived Channels

The Remove Derived Channels menu option removes copied or beamed channels created during the current analysis session. Derived or temporary beam channels are usually created in an attempt to boost the signal to noise ratio in a waveform segment. Beam channels created by the automatic system are not removed by this function.

To remove all derived channels:

1. Choose View > Remove Channels > Remove Derived Channels.

   All temporary channels are removed.

View > Remove Channels > Remove Blank Waveforms

The Remove Blank Waveforms menu option reduces the clutter on your display by removing channels that do not contain waveform data for their allocated time period. However, as an analyst you should not have to use this option often because an optimized list of display channels is provided to *ARS* by *ARSscan* (see "analyst_log Procedures" on page 312). Empty channels are generally removed at this time.

To remove blank waveforms:

1. Choose View > Remove Channels > Remove Blank Waveforms.

   All channels not containing waveform data for the allocated time period are removed from the *ARS* display.

View > Copy Channels

The Copy Channels menu option make copies of waveforms to display. The new channel can be selected, filtered, or scaled independently of the original, which is especially useful for comparing waveforms using different filter bands.

To copy channels:

1. Select a single channel.
2. Choose View > Copy Channels.

   The channels are copied and displayed directly underneath the selected channel.

View > Sort Channels

The Sort submenu has several options for ordering the display of channels, as shown in Figure 92.

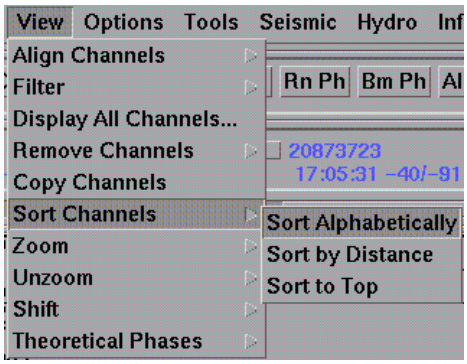
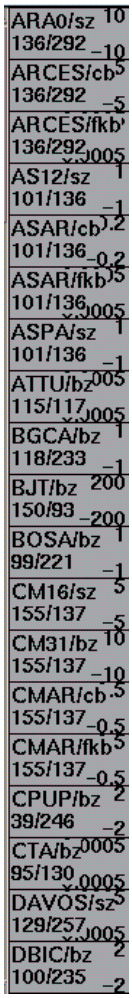


FIGURE 92. SORT SUBMENU UNDER VIEW

View > Sort Channels > Sort Alphabetically

For certain types of analysis it may be easiest to view the channels sorted alphabetically.



To sort alphabetically:

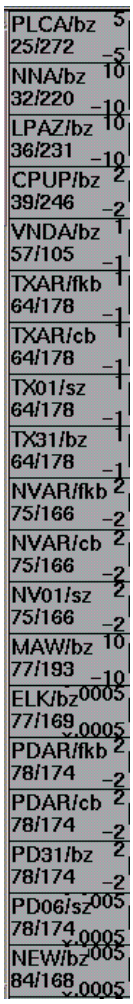
1. Choose View > Sort Channels > Sort Alphabetically. You need not select an event or channel.

   ARS redisplays the channels in alphabetical order, as shown in Figure 93.

FIGURE 93. CHANNELS SORTED ALPHABETICALLY

View > Sort Channels > Sort by Distance

The Sort by Distance menu option sorts channels by distance to the selected event. This sorting method is generally preferred for routine analysis.



To sort by distance:

1. Select an event.
2. Choose View > Sort Channels > Sort by Distance. You need not select channels or arrivals.

   The channels are sorted by distance to the selected event, as shown in Figure 94. The closest stations appear at the top of the display; the furthest stations appear at the bottom of the display. It is best to have a refined location to make sure that the sorting is accurate. You can sort more than once during the analysis of an event.

FIGURE 94. CHANNELS SORTED BY DISTANCE TO EVENT

View > Zoom

The Zoom submenu provides a number of options that expand the time scale so that more waveform detail is visible. The options are shown in Figure 95.

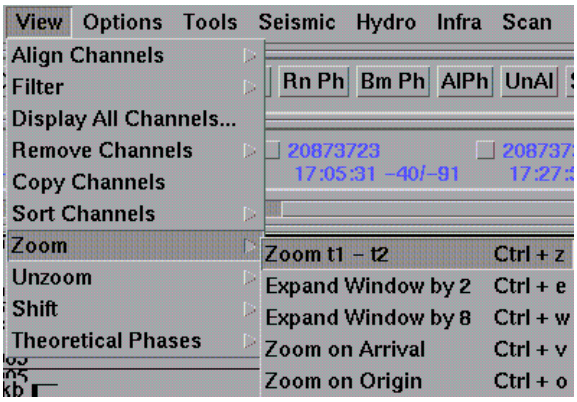


FIGURE 95. ZOOM SUBMENU UNDER VIEW MENU

View > Zoom > Zoom t1-t2

The time scale at the bottom of the *ARS* window shows the time span of the currently displayed waveforms and varies depending on the current zoom level ranging from hours to seconds. The t1 and t2 time markers can be set to bracket a subset of the current time window. The Zoom t1-t2 option zooms the waveform display to display just the time interval between the t1 and t2 markers.

To zoom t1–t2:

1. Position the t1 and t2 markers at the bottom of the *ARS* display. Move the markers by left-clicking and dragging them to the desired position.
2. Choose View > Zoom > Zoom t1-t2.

   ARS zooms into the time segment defined by the t1 and t2 markers. The time scale, and therefore the waveforms, expand. The arrivals shift their positions accordingly.

View > Zoom > Expand Window by 2

The Expand Window by 2 menu option zooms into exactly half the previously displayed window.

To expand the window by 2:

1. Choose View > Zoom > Expand Window by 2. You need not select an event or channel.

   ARS zooms into a window centered on one-half of the previously displayed window. The time scale is expanded by two.

View > Zoom > Expand Window by 8

The Expand Window by 8 menu option zooms into one eighth of the previously displayed window.

To expand the window by 8:

1. Choose View > Zoom > Expand Window by 8. You need not select an event or channel.

   ARS zooms into a window centered on one-eighth the previously displayed window. The time scale is expanded by eight.

View > Zoom > Zoom on Arrival

The Zoom on Arrival menu option zooms in on a selected arrival to expand detail on either side of the arrival.

To zoom on arrival:

1. Select a single arrival.
2. Choose View > Zoom > Zoom on Arrival.

   ARS zooms into a two-minute window centered around the selected arrival.

View > Zoom > Zoom on Origin

The Zoom on Origin menu option adjusts the waveform display to include all arrivals associated to the selected event. This action may zoom out as well as in depending on the current zoom level.

To zoom on origin:

1. Select an event.
2. Choose View > Zoom > Zoom on Origin.

   The time scale of the waveform display adjusts so that all associated arrivals appear within the displayed time window.

View > Unzoom

The Unzoom options generally undo or perform the opposite tasks from the Zoom options. They compress the time scale so that more of the waveform data may be seen in the display. Compressing the waveform display also has the effect of shifting more arrivals into the display. The Unzoom options are shown in Figure 96.

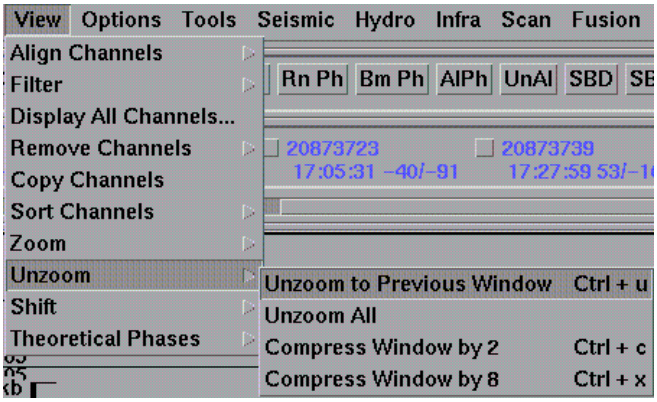


FIGURE 96. UNZOOM OPTIONS UNDER VIEW MENU

View > Unzoom > Unzoom to Previous Window

All of the zoom submenu options and the compress options described below save the current zoom level before performing the selected zoom action. The Unzoom to Previous Window menu option un-does the last zoom action to return the time scale to its previous zoom level. Unzoom can be repeated until the display is restored to its originally loaded time window. A maximum of 20 zoom levels are stored. There is no equivalent rezoom feature.

To return the display to the previous zoom level:

1. Choose View > Unzoom > Unzoom to Previous Window.

   The time scale of the waveform display adjusts to return to the previous zoom level. The display zooms in or out depending on the previous zoom level.

View > Unzoom > Unzoom All

The Unzoom All menu option unzooms the waveform display to the originally loaded time window. For example, if you had originally loaded four hours of data, Unzoom All displays the entire four hours of data. This option returns to the base zoom level, deleting all other saved zoom levels.

To unzoom all waveforms:

1. Choose View > Unzoom > Unzoom All. You need not select an event or channel.

   The time scale of the waveform display adjusts to display the entire time window originally loaded into *ARS*.

View > Unzoom > Compress Window by 2

The Compress Window by 2 menu option compresses the waveform display by a factor of 2. If 60 seconds of data are displayed, Compress Window by 2 compresses the waveforms to show 120 seconds of data.

To compress the window by a factor of 2:

1. Choose View > Unzoom > Compress Window by 2. You need not select an event or channel.

   All channels waveform data are compressed by a factor of two. Conversely, the time window of the waveform display is twice as long.

View > Unzoom > Compress Window by 8

The Compress Window by 8 option compresses the waveform display by a factor of 8. For example, if 60 seconds of data are displayed, this option compresses the waveforms to show 8 minutes of data.

To compress the window by a factor of 8:

1. Choose > View > Unzoom > Compress Window by 8. You need not select an event or channel.

   All channels' waveform data are compressed by a factor of 8. Conversely, the time window of the waveform display is eight times as long.

View > Shift

The Shift submenu options provide additional horizontal scrolling options to those provided by the scroll bar. Clicking in the scroll bar area shifts the waveform display one full-time window or page. Clicking on the arrows at either end of the scroll bar moves the display by smaller increments of 10 percent. The Shift submenu shown in Figure 97 adds shift increments of 25 percent and 50 percent.

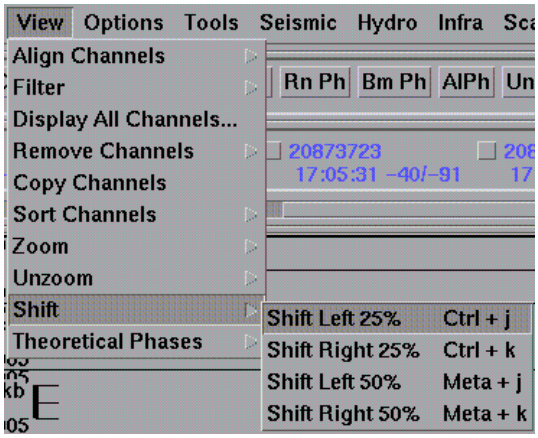


FIGURE 97. SHIFT OPTIONS UNDER VIEW MENU

View > Shift > Shift Left 25%

The Shift Left 25% menu option moves the waveforms to the left by 25 percent of the displayed time window.

To shift the waveforms left by 25 percent:

1. Choose View > Shift > Shift Left 25%.

   All waveforms and arrivals move one quarter of the time window to the left.

View > Shift > Shift Right 25%

The Shift Right 25% menu option moves the waveforms to the right by 25 percent of the displayed time window.

To shift the waveforms right by 25 percent:

1. Choose View > Shift > Right 25%.

   All waveforms and arrivals move one quarter of the time window to the right.

View > Shift > Shift Left 50%

The Shift Left 50% menu option moves the waveforms to the left by 50 percent of the displayed time window.

To shift the waveforms left by 50 percent:

1. Choose View > Shift > Shift Left 50%.

   All waveforms and arrivals move one half of the time window to the left.

View > Shift > Shift Right 50%

The Shift Right 50% menu option moves the waveforms to the right by 50 percent of the displayed time window.

To shift the waveforms right by 50 percent:

1. Choose View > Shift > Shift Right 50%.

   All waveforms and arrivals move one half of the time window to the right.

View > Theoretical Phases

You can display the theoretical arrival times for selected phases to aid in assessing detected arrivals. The Theoretical Phases submenu provides several options for defining and controlling the display of theoretical phases, as shown in Figure 98.

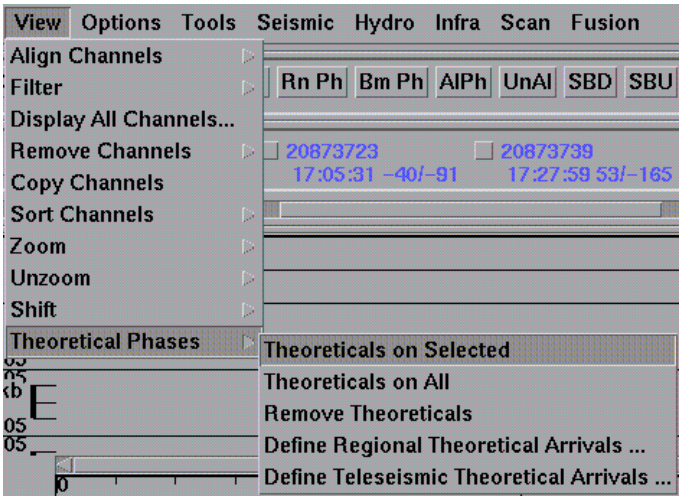


FIGURE 98. THEORETICAL PHASE DISPLAY OPTIONS UNDER VIEW MENU

View > Theoretical Phases > Theoreticals on Selected

The Theoreticals on Selected menu option displays selected theoretical arrival times on selected channels (Figure 99). This option is identical to the Th option in the *ARS* toolbar (see "Th – Theoretical Arrival Time" on page 54). Only one phase's theoretical can be displayed per invocation of this option; however, the theoretical will display on multiple selected stations and channels.

To display theoreticals on selected channels:

1. Select an event.
2. Select the channel(s) on which the theoretical arrival times should be displayed. To select multiple channels, press the shift key while selecting channels one at a time. To select all channels, press Control-p.
3. Choose View > Theoretical Phases > Theoreticals on Selected.

   A list of phases is displayed.

4. Select one phase whose theoretical arrival times should be displayed.

   The phase's theoretical arrival time is displayed on the selected channels, as shown in Figure 99.

5. If the theoretical arrival is not visible, align the waveforms on the selected phase (see "View > Align Channels > Align Theoretical…" on page 103).

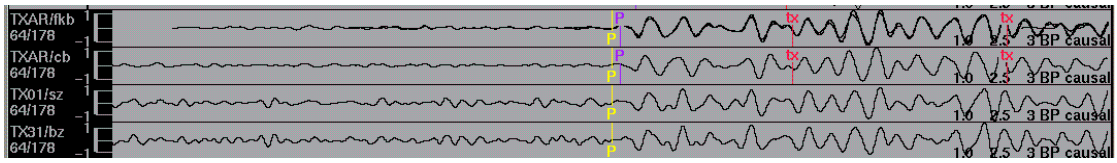


FIGURE 99. P PHASE THEORETICAL ARRIVAL DISPLAYED ON STATION TXAR

View > Theoretical Phases > Theoreticals on All

The Theoreticals on All menu option displays one or more theoretical arrivals on all currently displayed channels.

To display theoreticals on all channels:

1. Select an event. You need not select any channels.
2. Choose View > Theoretical Phases > Theoreticals on All.

   A list of phases is displayed.

3. Select one or more phases whose theoretical arrival times should be displayed, then click Done.

   The selected theoretical phases are displayed on all channels. (Certain phases will not be displayed at certain distances from an event. *ARS* displays only those theoreticals at stations that are likely to record them based on distance from the event.) The theoretical arrival times are based on the selected event's current location.

View > Theoretical Phases > Remove Theoreticals

You can remove theoretical phases from the display to remove clutter from the *ARS* screen or, if a location has been updated, to make the theoretical arrival times no longer current.

To remove theoreticals:

1. Choose View > Theoretical Phases > Remove Theoreticals. You need not select an event or channel.

   All theoretical phases on all channels are removed from the *ARS* display.

View > Theoretical Phases > Define Regional Theoretical Arrivals...

The Define Regional Theoretical Arrivals... menu option is linked with the Show Regional Theoretical Arrivals option under the "Seismic Menu" on page 145. This Define option allows you to build a custom theoretical phase list, and the Show option displays it. The Define option allows you to select those theoretical phases that you would like displayed when analyzing events at regional distances (less than 20 degrees).

To define regional theoretical arrivals:

1. Choose View > Theoretical Phases > Define Regional Theoretical Arrivals... You need not select an event or channel. *ARS* displays a list of theoretical phases.
2. Select one or more phases whose arrival times are to be displayed, then click Done.

   ARS saves a new default list for regional theoretical phases. When Show Regional Theoretical Arrivals is chosen, *ARS* displays the theoretical phases in this list. The list defined with this option remains in effect for the remainder of the analysis session or until it is redefined using this option.

View > Theoretical Phases > Define Teleseismic Theoretical Arrivals...

The Define Teleseismic Theoretical Arrivals... option is linked with the Show Teleseismic Theoretical Arrivals option under the "Seismic Menu" on page 145. This Define option allows you to build a custom theoretical phase list; the Show option displays it. This Define option allows you to select those theoretical phases that you would like displayed when analyzing events at teleseismic distances (greater than 20 degrees).

To define teleseismic theoretical arrivals:

1. Choose View > Theoretical Phases > Define Teleseismic Theoretical Arrivals... You need not select an event or channel

   ARS displays a list of theoretical phases.

2. Select one or more phases whose arrival times are to be displayed, then click Done.

   ARS saves a new default list for teleseismic theoretical phases. When Show Teleseismic Theoretical Arrivals is selected, *ARS* displays the theoretical phases in this list. The list defined with this option remains in effect for the remainder of the analysis session or until it is redefined using this option.

Options Menu

The Options menu provides options to enable or disable the display of certain components of the *ARS* waveform display, as shown in Figure 100.

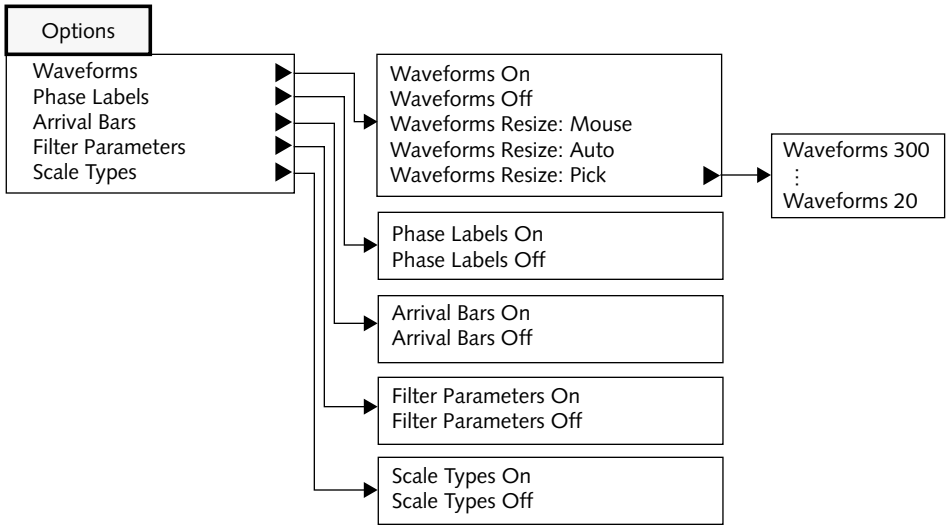


FIGURE 100.ARS OPTIONS MENU

For reference, Figure 101 shows the typically configured *ARS* waveform display with waveforms, phase labels, arrival bars, and filter options all enabled and scale type disabled. Figures 102 through 110 can be compared to this figure.

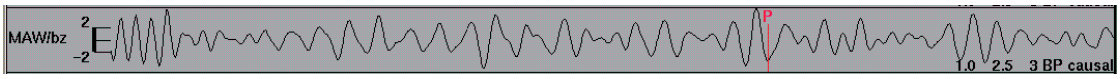


FIGURE 101.NORMAL ARS DISPLAY

Options > Waveforms

The two Waveforms submenu options toggle the display of the waveform trace. Turning off the waveform trace replaces it with a horizontal line where data exist. You can use this option to make scrolling faster.

Options > Waveforms > Waveforms On

The Waveforms On option draws waveforms on all channels.

To display waveforms:

1. Choose Options > Waveforms > Waveforms On.

   Waveforms for all channels are displayed.

Options > Waveforms > Waveforms Off

The Waveforms Off option turns off drawing actual waveforms, and replaces them with a horizontal line on each channel (Figure 102). Horizontal lines are drawn only where data are available to indicate the presence or absence of data in the channel.

To turn off waveforms:

1. Choose Options > Waveforms > Waveforms Off.

   The waveforms disappear and are replaced by horizontal lines on each channel.

FIGURE 102. WAVEFORM TRACE TURNED OFF

Options > Waveforms > Waveforms Resize: Mouse

As you horizontally scroll the waveform display, *ARS* automatically rescales the waveforms to fit inside the designated space for each channel. However, occasionally this is not desirable. A large noise spike may exist on a channel; when *ARS* scales the channel to accommodate this spike, normal amplitude variation may be difficult to distinguish. You may also wish to keep the waveform display's ampli-

tude larger than normal, to see detail in a signal. The Waveforms Resize: Mouse option allows you to set the amplitude scale of the waveform in the display and to keep it at this value while scrolling from window to window with waveform auto-scaling disabled. This option applies to all channels in the waveform display. Individual channels may be rescaled at your discretion (see "Amplitude Scaling and Measurement" on page 32). *ARS* will not auto-scale or change any channel's scaling value as the display is scrolled or zoomed.

To resize the waveform display by using your mouse buttons:

1. Choose Options > Waveforms > Waveforms Resize: Mouse. You need not select events or channels.

   ARS disables auto scaling as you scroll through different time windows, maintaining a constant amplitude scaling for each channel.

Options > Waveforms > Waveforms Resize: Auto

If waveform autoscaling has been disabled by the Waveforms Resize: Mouse option, it can be enabled by using the Waveforms Resize: Auto option. *ARS* will again auto-scale waveforms during scroll and zoom operations.

To automatically resize the waveforms during scrolling:

1. If Waveforms Resize: Mouse is enabled, choose Options > Waveforms > Waveforms Resize: Auto.

   ARS automatically rescales the waveforms during scrolling. This means that as you scroll vertically or horizontally, the waveform height is adjusted to fit the maximum amplitude in the display space provided for each channel. Enabling auto-scaling applies to all channels.

Options > Waveforms > Waveforms Resize: Pick

You can adjust the height of each channel's waveform display box. To see more channels on the display, use a smaller waveform display box; to see more detail in individual channels, increase the waveform height, and show fewer channels. Figure 103 shows the waveform height options. The default channel height used by *ARS* at startup is 45 pixels.

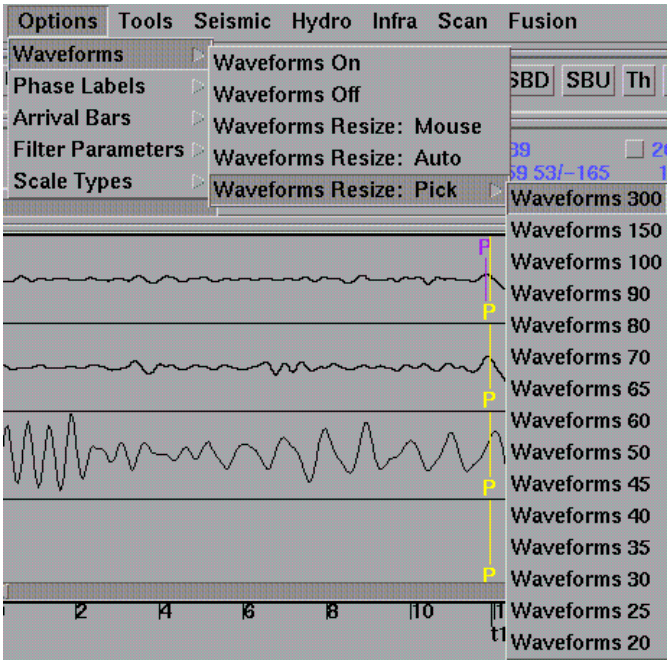


FIGURE 103. WAVEFORM HEIGHT SELECTION

To adjust the height of a waveform:

1. Choose Options > Waveforms > Waveforms Resize: Pick.
2. Select the desired waveform height. Height is given in pixels.

   The *ARS* screen refreshes, and the waveform display area allocated to each channel changes to the height selected.

Options > Phase Labels

Phase labels contain the phase names assigned to each arrival. They appear above the arrival bars within the waveform display box. Phase labels are normally displayed. However, when data are compressed to display many hours of data, for example at initial data load, display of phase labels will be disabled. As you zoom in on the data, phase labels are displayed. With these menu options, analysts can display phase labels in compressed data before zooming or, once zoomed in, you can undisplay phase labels (for example, if the phase label is obscuring detail in a waveform). Phase label options are shown in Figure 104.

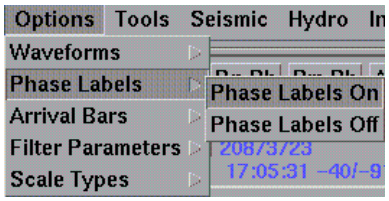


FIGURE 104. PHASE LABEL TOGGLES UNDER OPTIONS MENU

Options > Phase Labels > Phase Labels On

To display phase labels:

1. If phase labels are not displayed in *ARS*, choose Options > Phase Labels > Phase Labels On.

   The phase labels are displayed.

Options > Phase Labels > Phase Labels Off

1. If the phase labels are displayed in *ARS*, choose Options > Phase Labels > Phase Labels Off.

   The phase labels disappear from the *ARS* display, as shown in Figure 105.

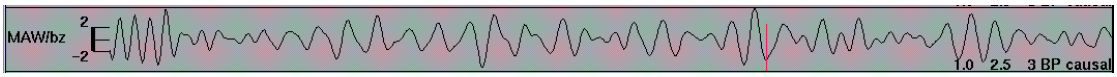


FIGURE 105.PHASE LABELS TURNED OFF

Options > Arrival Bars

Arrival bars are small vertical lines within the waveform display box that mark the location of an arrival's detection time. You can display or undisplay them. By default they are displayed when *ARS* first loads data. You can undisplay them if they obscure detail in the waveform. Arrival Bar options are shown in Figure 106.

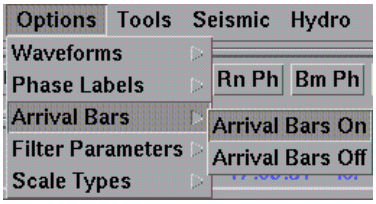


FIGURE 106.ARRIVAL BAR DISPLAY OPTIONS UNDER OPTIONS MENU

Options > Arrival Bars > Arrival Bars On

To turn on arrival bars:

1. If arrival bars are undisplayed, choose Options > Arrival Bars > Arrival Bars On.

   Arrival bars appear in the *ARS* display.

Options > Arrival Bars > Arrival Bars Off

To turn off arrival bars:

1. If arrival bars are displayed, choose Options > Arrival Bars > Arrival Bars Off.

   Arrival bars disappear from the *ARS* display, as shown in Figure 107.

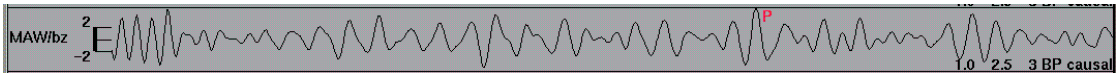


FIGURE 107. ARRIVAL BARS TURNED OFF

Options > Filter Parameters

By default *ARS* describes the current filter applied to each waveform. Filter parameters appear on the far right of the displayed waveform similar to that shown in Figure 107. You can enable or disable displaying this information.

Options > Filter Parameters > Filter Parameters On

To turn on filter parameters:

1. If filter parameters are undisplayed, choose Options > Filter Parameters > Filter Parameters On.

   The filter parameters currently applied to each waveform are displayed. No information appears if the trace is not filtered.

Options > Filter Parameters > Filter Parameters Off

To turn off filter parameters:

1. If filter parameters are displayed, choose Options > Filter Parameters > Filter Parameters Off.

   The filter information disappears from all channels, as shown in Figure 108.

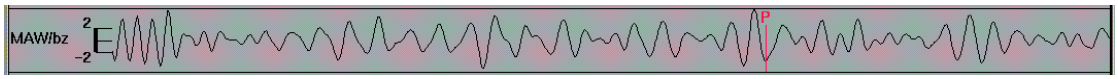


FIGURE 108. FILTER PARAMETERS TURNED OFF

Options > Scale Types

Although normally undisplayed, you can display the waveform scaling resize option currently in effect. The Scale Types options are shown in Figure 109. With this option enabled, *ARS* displays one of two messages: `auto` or `resize` depending on whether waveform auto-scaling is currently enabled. Resize indicates auto-scaling has been disabled by the Waveforms Resize: Mouse option. The Scale Types message is shown on the far right of the displayed waveform often with the filter parameters message as shown in Figure 110.

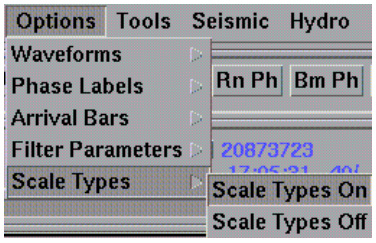


FIGURE 109. SCALE TYPE DISPLAY OPTIONS UNDER OPTIONS MENU

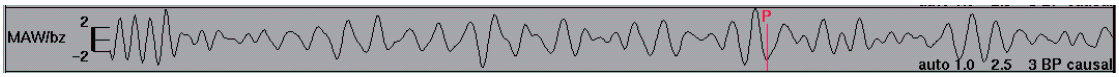


FIGURE 110.SCALE TYPE DISPLAY TURNED ON

Options > Scale Types > Scale Types On

To display scale types:

1. If the scale type is undisplayed, choose Options > Scale Types > Scale Types On.

   The waveform scaling resize option is displayed (Figure 110).

Options > Scale Types > Scale Types Off

To undisplay scale types:

1. If the waveform scaling resize option is displayed, choose Options > Scale Types Off.

   The scale type disappears from all channels on the waveform display.

Tools Menu

The Tools Menu lists other applications in the interactive suite that *ARS* can access to perform specific analysis tasks. For example, *XfkDisplay* provides an interactive display in which you can acquire more detailed information about the azimuth and slowness of an arrival. The *SpectraPlot* tool provides spectral analysis on a selected waveform segment. The applications in the Tools menu communicate with *ARS* using an IPC called Tuxedo. The Tuxedo client *dman* monitors application status and starts each application as necessary to respond properly to messages sent from *ARS* (see "dman" on page 364). The Tools Menu is shown in Figure 111.

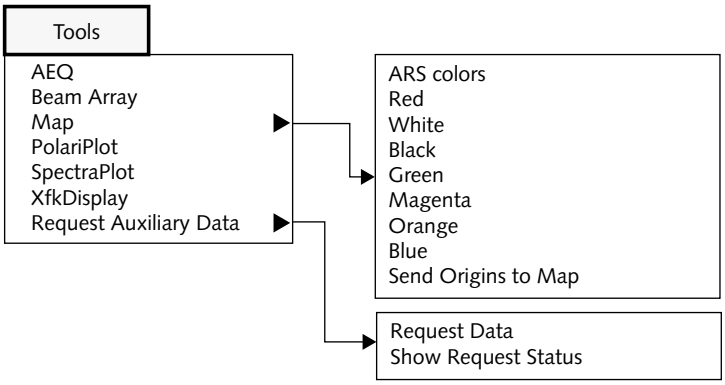


FIGURE 111. TOOLS MENU

Tools > AEQ

The AEQ (Anomalous Event Qualifier) menu option launches the *AEQ* tool. After analyzing an event you may want to run *AEQ*, which provides a probability that the event is anomalous based on a statistical analysis of historical data (see "Anomalous Event Qualifier (AEQ) Procedures" on page 244).

To use the *AEQ* tool:

1. Select an event.
2. Choose Tools > AEQ.

   If not already active, *AEQ* launches. It is configured to display on the screen opposite the main *ARS* display. The selected event is analyzed, and the results are displayed. See "Anomalous Event Qualifier (AEQ) Procedures" on page 244 for interpretation of results. *AEQ* runs until you stop it. You can send a new event to *AEQ* at any time.

Tools > Beam Array

Beamforming is a process of enhancing coherent signals relative to background noise by delaying and summing array station channel data to emphasize energy arriving at the array from a particular direction such as a theoretical event location.

"Beaming" is performed by the *DFX* application [IDC7.1.1]. The Beam Array menu option initiates interactive recall processing to have *DFX* form beamed data for the selected station around the selected theoretical arrival time oriented toward the selected event. This option performs the same function as Beam, which is located in the toolbar.

To use the Beam Array tool:

1. Select an event.
2. Select either the fk beam or cb beam on an array station, (a cb-derived channel is always returned).
3. Choose Tools > Select Beam Array.

   A list of phases appears.
4. Select the phase on which to beam. This determines the theoretical arrival time around which the beam interval should be created.

   An *ARS* dialogue box appears during beam processing, locking the *ARS* screen. Beaming should take approximately 15 seconds, after which time the *ARS* screen is released and the beamed channel is displayed. The new channel is sorted by distance from the event, and is aligned on the theoretical arrival time of the selected phase.

Tools > Map

The Map menu option launches the *Map* application. *Map* presents a graphical representation of the earth's surface to which you can send objects for geographical display (see "Map Procedures" on page 225). The *Map* submenu shown in Figure 112 provides options to choose a preferred color for plotting the object on the map.

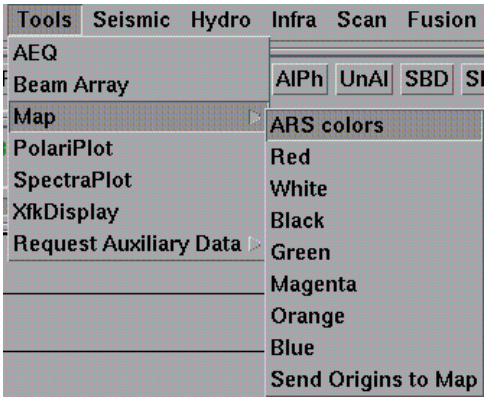


FIGURE 112. MAP SUBMENU

To launch *Map* for the purpose of plotting the location of an event, a station, an arrival's station, or a combination:

1. Select the desired objects.
2. Choose Tools > Map > (option) to select the desired color for the object to be plotted.

   The ARS colors submenu option plots the object in the color it has in *ARS*. The Send Origins to Map option sends all origins in the loaded time period to *Map*.

   If not already active, *Map* launches. *Map* is configured to display on the screen opposite the *ARS* display screen. The selected objects are plotted on the *Map*. *Map* runs until you stop it. You can send new objects to *Map* at any time.

Tools > PolariPlot

The PolariPlot menu option launches *PolariPlot*. *PolariPlot* is a polarization tool used to calculate rectilinearly, azimuth, and slowness along the time-series of an incoming wavefront recorded on three orthogonal seismological components (see "PolariPlot Procedures" on page 274).

To launch *Polariplot*:

1. Select either a 3-C station or a 3-C element of an array station. The traces may be either filtered or unfiltered, but all 3-C channels must be selected.
2. Position the t1 and t2 markers to delineate the time interval of data to be processed.
3. Choose Tools > PolariPlot.

If not already active, *PolariPlot* launches. *PolariPlot* displays rectilinearity, azimuth, and slowness traces for the selected station and time interval. *PolariPlot* runs until you stop it; you can send new station data to *PolariPlot* at any time.

Tools > SpectraPlot

The SpectraPlot menu option launches the *SpectraPlot* tool. *SpectraPlot* provides spectral analysis, which is displayed as power versus frequency, of a channel waveform's segment (see "SpectraPlot Procedures" on page 291).

To launch *SpectraPlot*:

1. Select one or more channels.
2. Position the t1 and t2 markers to delineate the time interval of data to be processed. You can send more than one channel's data to *SpectraPlot* at a time.
3. Choose Tools > SpectraPlot.

   If not already active, *SpectraPlot* launches. *SpectraPlot* is configured to display on the screen opposite the *ARS* display. *SpectraPlot* displays the power spectrum of the waveform. *SpectraPlot* remains running until you stop it. You can send new channels to *SpectraPlot* at any time.

Tools > XfkDisplay

The XfkDisplay menu option launches the *XfkDisplay* tool. *XfkDisplay* allows you to visually interpret station-to-event azimuth and slowness for an arrival (see "XfkDisplay Procedures" on page 201).

To launch *XfkDisplay*:

1. Select an arrival. To select more than one arrival to send to *XfkDisplay*, press the Shift key and select the arrivals one at a time.
2. Choose Tools > XfkDisplay.

   If not already active, *XfkDisplay* launches. You can analyze the arrival's azimuth and slowness. You can return updated azimuth and slowness parameters to *ARS*. *XfkDisplay* runs until you stop it; you can send new arrivals to *XfkDisplay* at any time.

Tools > Request Auxiliary Data

You can request additional waveform data from auxiliary stations for display in *ARS*. The Request Auxiliary Data submenu offers two options, as shown in Figure 113. These options allow you to request data and to see the status of the request.

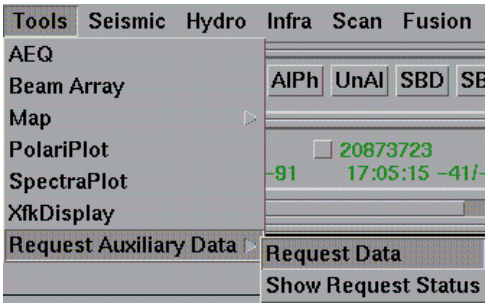


FIGURE 113. INTERACTIVE AUXILIARY DATA REQUEST OPTIONS UNDER TOOLS

Tools > Request Auxiliary Data > Request Data

The Request Data submenu option allows you to initiate a request for auxiliary data that can be used to improve an event's location estimate. You should refine an event as much as possible before requesting auxiliary data. Auxiliary data requests are made for specific time intervals based on the theoretical arrival time of a P phase at the selected station. With a refined location, *IADR* requests a more appropriate time interval for the event.

To request auxiliary data:

1. Select an event.
2. Choose Tools > Request Auxiliary Data > Request Data.

   If not already active, *IADR* launches. A dialogue box labeled *WEAssess* appears on the display opposite the *ARS* screen. This *WEAssess* dialogue box allows you to make the auxiliary data requests (see "Interactive Auxiliary Data Request (IADR) Procedures" on page 248).

Tools > Request Auxiliary Data > Show Request Status

The Show Request Status submenu option tracks the status of auxiliary data requests. The Interactive Auxiliary Data Request tool also displays the request status dialogue box.

To show request status:

1. Choose Tools > Request Auxiliary Data > Show Request Status. You need not select anything in *ARS*, because *IADR* displays all requests for the loaded time period. This includes any requests made by the Automatic Processing software before the SEL3 was created; these requests are displayed in *IADR* as SEL1 and SEL2.

   If not already active, *IADR* launches. *IADR* is currently configured to display the status dialogue on the screen opposite the *ARS* screen. See "Interactive Auxiliary Data Request (IADR) Procedures" on page 248 for checking status and displaying data. You can display the *IADR* status for the duration of the *ARS* session to monitor subsequent data requests.

Seismic Menu

The Seismic menu provides options relevant to analyzing seismic data, as shown in Figure 114.

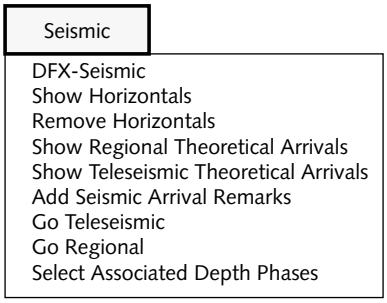


FIGURE 114. SEISMIC MENU

Seismic > DFX-Seismic

The DFX-Seismic menu option allows you to run the *DFX* application interactively. This application is first run during automatic processing. *DFX* searches waveform data for signal-to-noise ratios exceeding a certain threshold at which point an arrival is created. *DFX* then performs signal measurements on the waveform data in the vicinity of the arrival and records the results in the database.

The DFX-Seismic option performs processing on arrivals that were added or refined during analysis. Both *XfkDisplay* and DFX-Seismic compute azimuth and slowness for an arrival; however, DFX-Seismic also computes period and amplitude, which are necessary to compute a station magnitude. (*DFX* will not replace an *XfkDisplay* result already transferred to *ARS*.)

If many events occur close to the same time, DFX-Seismic results may be used to determine which arrival belongs to which event. An anomalous amplitude value compared to other associated arrivals may indicate the arrival has been associated to the wrong event.

To launch *DFX*:

1. Select an arrival.
2. Choose Seismic >DFX-Seismic.

   A processing dialogue box appears, as shown in Figure 115. The *ARS* screen is locked. (You may abort the *DFX* processing by clicking Abort.)

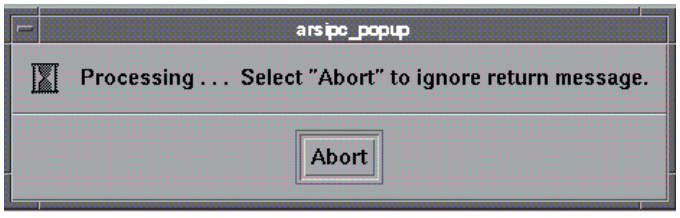


FIGURE 115.DFX PROCESSING DIALOGUE BOX

When *DFX* processing is complete *ARS* displays a message indicating that the *DFX* message was received. If an error occurs and feature extraction is not successful, *ARS* displays a warning message. For successful feature measurement, AlphaList azimuth, slowness, period, and amplitude fields are updated. For depth phases only, the snr for the depth phase field also contains the calculated snrs.

Seismic > Show Horizontals

The Show Horizontals option allows you to display horizontal channels for all stations that have those channels.

To show horizontals:

1. Select an event.
2. Select one or more channels. To select multiple channel, press the Shift key while selecting the additional channels.
3. Choose Seismic > Show Horizontals.

   The *ARS* screen refreshes, and the horizontal channels for the selected stations appear at the bottom of the waveform display. Select Sort By Distance from the toolbar to sort the added channels by distance from the event.

Seismic > Remove Horizontals

The Remove Horizontals menu option removes horizontal channels from the *ARS* display using one operation.

To remove horizontals:

1. Choose Seismic > Remove Horizontals. You need not select an event or channel.

   All horizontal channels are removed from the *ARS* display.

Seismic > Show Regional Theoretical Arrivals

The Show Regional Theoretical Arrivals menu option invokes the following default list of theoretical arrival times, if the list was not modified by the Define Regional Theoretical Arrivals option: "Pn", "Pg", "Sn", "Lg", and "Rg".

To show regional theoretical arrivals:

1. If preferred, first use Define Regional Theoretical Arrivals…
2. Select an event to be analyzed regionally.
3. Choose Seismic > Show Regional Theoretical Arrivals.

   Regional theoretical arrivals are placed at their predicted arrival times on the waveform display. Theoretical arrival times are based on the event's current location.
4. If you update the location, remove the theoretical arrivals from the display by choosing View > Remove Theoreticals or by selecting ThO from the toolbar; then redisplay them to update the arrival times for the new location.

Seismic > Show Teleseismic Theoretical Arrivals

The Show Teleseismic Theoretical Arrivals menu option invokes the following default list, if the list was not modified by the Define Teleseismic Theoretical Arrivals option: "P", "pP", "sP", "PP", "PcP", "PKP", "S", and "LQ".

1. If preferred, first use Define Teleseismic Theoretical Arrivals…
2. Select an event to be analyzed at teleseismic distances.
3. Choose Seismic > Show Teleseismic Theoretical Arrivals.

   Teleseismic theoretical arrivals are placed at their predicted arrival times on the waveform display. Theoretical arrival times are based on the event's current location.

4. If you update the location, remove the theoretical arrivals from the display by choosing View > Remove Theoreticals or by selecting ThO from the toolbar; then redisplay them to update the arrival times for the new location.

Seismic > Add Seismic Arrival Remarks

The Add Seismic Arrival Remarks menu option adds a remark regarding a specific seismic arrival. This remark may then be read by other analysts or during bulletin quality control. Unlike other Remarks options in the *ARS* Edit menu (see "Edit > Remarks" on page 96), you can only add a preformatted remark using this option.

To add seismic arrival remarks:

1. Select a single arrival on a seismic station.
2. Choose Seismic > Add Seismic Arrival Remarks.

   A list of remarks appears, as shown in Figure 116.
3. Choose the appropriate comment, then click Done.

   The remark is attached to the arrival.
4. To view the remark, choose Edit > Remarks > Show Remarks on Selected, as described on page 98.

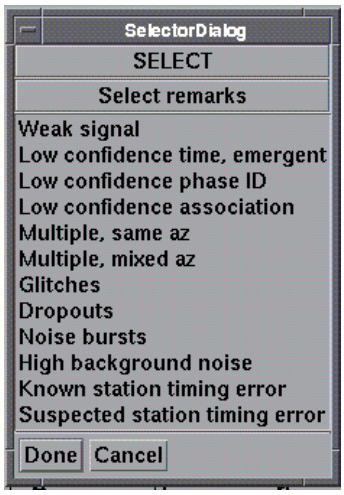


FIGURE 116. LIST OF SEISMIC ARRIVAL REMARKS

Seismic > Go Teleseismic

The Go Teleseismic menu option performs a sequence of operations. It zooms to display all the arrivals associated to an event in one screen. It aligns on P phase and sorts the stations by distance from the event.

To use the Go Teleseismic operations:

1. Select an event to be analyzed at teleseismic distances.
2. Choose Seismic > Go Teleseismic.

   ARS aligns on the P phase, sorts the stations by distance from the event, and finally compresses or zooms the waveform display so that all arrivals for the event are displayed horizontally on one screen.

Seismic > Go Regional

The Go Regional menu option performs a sequence of operations. It zooms to display all arrivals associated to an event in one screen. It aligns on the Pn phase and sorts the stations by distance from the event.

To use the Go Regional operations:

1. Select an event to be analyzed at regional distances.
2. Choose Seismic > Go Regional.

   ARS aligns on the Pn phase, sorts the stations by distance from the event, and compresses or zooms the waveform display so that all arrivals associated for the event are displayed horizontally on one screen.

Seismic > Select Associated Depth Phases

During routine analysis, you may run DFX-Seismic for all depth phases associated with an event. The Select Associated Depth Phases option facilitates this operation. After you choose this option, you can display depth phases in AlphaList, or you can run *DFX* recall processing on them. When *DFX* is run on a depth phase, it calculates a standard period and amplitude, and a depth-phase-specific snr. This snr appears in AlphaList *dsnr* field.

To select associated depth phases:

1. Select an event.
2. Choose Seismic > Select Associated Depth Phases.

   All currently selected arrivals are de-selected, and all associated depth phases are selected.

Hydro Menu

The Hydro menu provides options for analyzing hydroacoustic data. The Hydro menu options are shown in Figure 117.

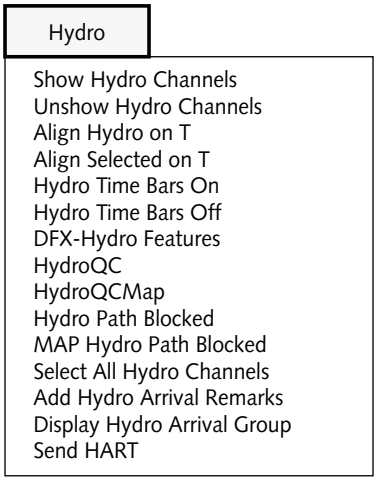


FIGURE 117. HYDRO MENU

Hydro > Show Hydro Channels

Analyzing hydroacoustic waveform data is usually the last step in analyzing an event. The Show Hydro Channels option displays a group of hydroacoustic stations at the top of the *ARS* display.

To show hydroacoustic channels:

1. Select an event, if desired.
2. Choose Hydro > Show Hydro Channels. You need not select channels.

   All hydroacoustic channels are positioned at the top of the *ARS* display. If an event is selected, the waveform data are aligned on the theoretical H/T phase. Both T and H phases are considered by *ARS* to have the same theoretical arrival times.

Hydro > Unshow Hydro Channels

The Unshow Hydro Channels option undisplays all hydroacoustic channels. Undisplaying hydroacoustic data relieves you from having to scroll through unnecessary data.

To display hydroacoustic channels:

1. If hydroacoustic stations are displayed, choose Hydro > Unshow Hydro Channels. You need not select an event or channel.

   All hydroacoustic channels are removed from the display.

Hydro > Align Hydro on T

The Align Hydro on T menu option aligns hydroacoustic data on a theoretical T phase arrival time after you create an event or update its location.

To align hydroacoustic data on a theoretical T phase arrival time:

1. Make certain that hydroacoustic data are displayed.
2. Choose Hydro > Align Hydro on T.

   The waveform data align on the theoretical arrival time for T/H, placing it in the middle of the *ARS* display.

Hydro > Align Selected on T

The Align Selected on T menu option aligns selected stations on T.

To align selected stations on T:

1. Make certain that hydroacoustic waveform data are displayed.
2. Select one or more stations.
3. Choose Hydro > Align Selected on T.

   The selected station's waveform data align on T, placing them in the middle of the *ARS* display.

Hydro > Hydro Time Bars On

Before you review hydroacoustic arrivals, the Automatic Processing software evaluates each hydroacoustic arrival and records their properties in the database. Two of these are the time at which the arrival signal begins and the time at which it ends. These times are also known as signal onset and termination times.

You can interactively adjust the onset and termination times of a hydroacoustic signal. The Hydro Time Bars On menu option allows you to see where the Automatic Processing software placed the onset/termination times.

To display hydroacoustic time bars:

1. Select a single hydroacoustic arrival.
2. Choose Hydro > Hydro Time Bars On.

   Two small vertical bars with arrows on top appear in the waveform, as shown in Figure 118. These bars represent the most recently calculated onset/termination times for the signal. Changes that have been made interactively to the onset/termination times are indicated by highlighted change bars, as shown in Figure 119.

To see signal onset/termination times for an added arrival, onset/termination times must have been calculated using DFX-Hydro Features.

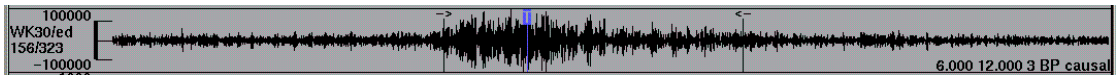


FIGURE 118. ONSET/TERMINATION BARS AROUND HYDROACOUSTIC SIGNAL

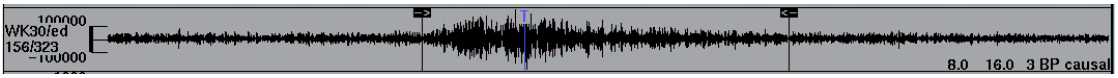


FIGURE 119. ANALYST-ADJUSTED ONSET/TERMINATION BARS

Hydro > Hydro Bars Off

The Hydro Bars Off option allows you to undisplay onset/termination time bars when you are not using them.

To turn off hydroacoustic bars:.

1. Select a single arrival whose onset/termination time bars are being displayed.
2. Choose Hydro > Hydro Bars Off.

   The onset/termination time bars disappear.

Hydro > DFX-Hydro Features

The *DFX* application is first run during automatic processing. *DFX* searches waveform data for signal-to-noise ratios exceeding a certain threshold, at which point an arrival is created. *DFX* then performs signal measurements on the waveform in the vicinity of the arrival and records the results in the database. Different frequency bands are used for hydroacoustic data than for seismic data. Of the eight frequency bands used, *ARS* displays the features calculated at the frequency band producing the highest snr.

Three hydroacoustic features can be interactively modified. These are arrival time, filter band for optimizing amplitude, and onset and termination times. If you add a detection or modify the editable hydroacoustic features, you should invoke the DFX-Hydro Features option to recompute the arrival's automatically determined hydroacoustic features.

While *DFX* computes features based on detection time for a seismic arrival, it computes features based on onset and termination time for a hydroacoustic arrival and recomputes the arrival's detection time in the process. Hydroacoustic detection time is based on an estimate of the time of highest amplitude. If you prefer a different arrival time, run *DFX* first, and then retime the arrival to save your preferred arrival time in the database.

There are two procedures for hydroacoustic phases: one for examining existing arrivals and one for adding arrivals. Both involve close examination of the filter band used to extract features and the onset/termination times of the signal.

To examine existing arrivals:

1. Select the arrival.

2. Choose Hydro > Hydro Time Bars On (see "Hydro > Hydro Time Bars On" on page 153).

   The onset/termination bars surround the signal. The waveform is automatically filtered at a filter band judged by the Automatic Processing software to contain the highest snr for that signal. This filter is identified to the right of the waveform (similar to Figure 87 on page 108).

   You can make changes to the onset/termination bars. You can also choose a better filter for extracting features. To do so, filter the channel at different hydroacoustic filter bands until the highest apparent signal amplitude is shown in the waveform display. When satisfied, use the DFX-Hydro option to recompute the hydroacoustic features using the new filter band.

   After interactive *DFX* processing is complete, the filter band you selected is displayed. The onset/termination bars are highlighted, indicating a modified state, and they occupy positions that you selected. Other statistical information is calculated based on your modified settings.

To add arrivals:

1. Filter the waveform at different hydroacoustic frequencies.
2. Select the waveform that displays the highest snr.
3. Indicate the signal's onset and termination times by placing the t1 and t2 markers where appropriate, surrounding the signal.
4. Add an arrival within the selected onset and termination times (see "Edit > Add Arrival…" on page 86). You can add the arrival at the highest amplitude of the signal, but keep in mind that *DFX* may shift the arrival's position when it calculates highest amplitude.
5. When complete, choose Hydro > DFX-Hydro.

   The onset and termination times and optimal filter band used for the signal are those you specified, and the arrival time is recalculated. (You may notice the displayed arrival bar shift to the time calculated by *DFX*.)

Hydro > HydroQC

ARS provides some guidance for associating hydroacoustic phases. Hydroacoustic phases cannot be associated to an event that is blocked by a large land mass. The HydroQC menu option uses the position of the detecting hydrophone and the location of the event to determine whether a clear water path exists between the two. If it does not, HydroQC alerts you that a land mass is blocking the travel path and that detection is unlikely.

To use HydroQC:

1. Select an event.
2. If hydroacoustic phases are associated to the event, choose Hydro > HydroQC.

   HydroQC returns a message, either reporting that no blocked path for the associated hydroacoustic phases was found, as shown in Figure 120, or that one or more paths are blocked as shown in Figure 121.

Because the coupling mechanism for T-phases is uncertain, a two-degree margin of error is built into the HydroQC warning system, and therefore blockage by smaller land masses may not trigger a warning from HydroQC.

popupText
Hydroacoustic path check for orid 20877646
No Blocked Hydroacoustic Paths Were Found For Associated Hydroacoustic Phases.
Done

FIGURE 120.HYDROQC SHOWING NO BLOCKED PATHS

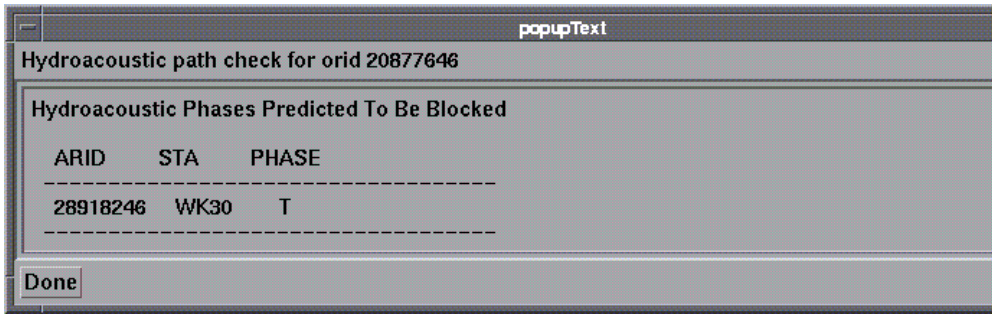


FIGURE 121. HYDROQC SHOWING PHASES ARE BLOCKED

Hydro > HydroQCMap

The HydroQCMap menu option provides the same display and warning message as the HydroQC option, but it also displays a map showing the travel paths of all associated hydroacoustic phases. The travel path is drawn as a great circle line between station and event. Figure 122 shows a travel path, which does not appear to be blocked. If the path is blocked, it is drawn in red; otherwise, it is drawn in green. The map background can be used to verify HydroQC's predictions.

To use HydroQCMap:

1. Select an event.
2. If hydroacoustic phases are associated to the event, choose Hydro > HydroQCMap.

   HydroQCMap returns a message indicating either that no blocked paths were found or that one or more paths are blocked. Simultaneously, *Map* is launched, which displays the paths for all associated hydroacoustic phases.
3. Review the HydroQC message and the *Map* display to verify HydroQC's assessment.

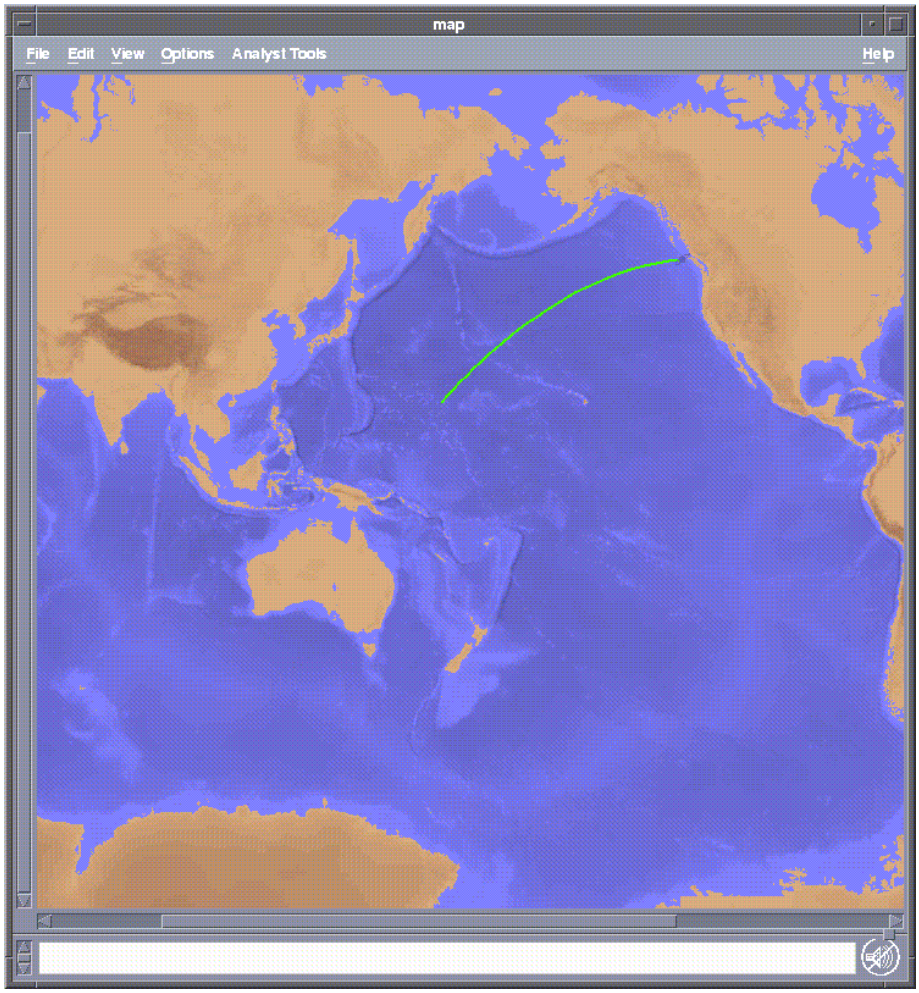


FIGURE 122. EXAMPLE TRAVEL PATH DISPLAYED IN MAP

Hydro > Hydro Path Blocked

The Hydro Path Blocked menu option is similar to the HydroQC option. However, instead of checking for blockage for associated hydroacoustic phases, the Hydro Path Blocked tool allows you to check for blockage to a hydrophone station before a phase is associated.

To use the Hydro Path Blocked tool:

1. Select an event.
2. Select one or more hydroacoustic stations for which you want to check blockage.
3. Choose Hydro > Hydro Path Blocked.

   Hydro Path Blocked returns a message indicating either that no path blockage to the selected station(s) was found or that the station is likely to be blocked from the event, as shown in Figure 123.

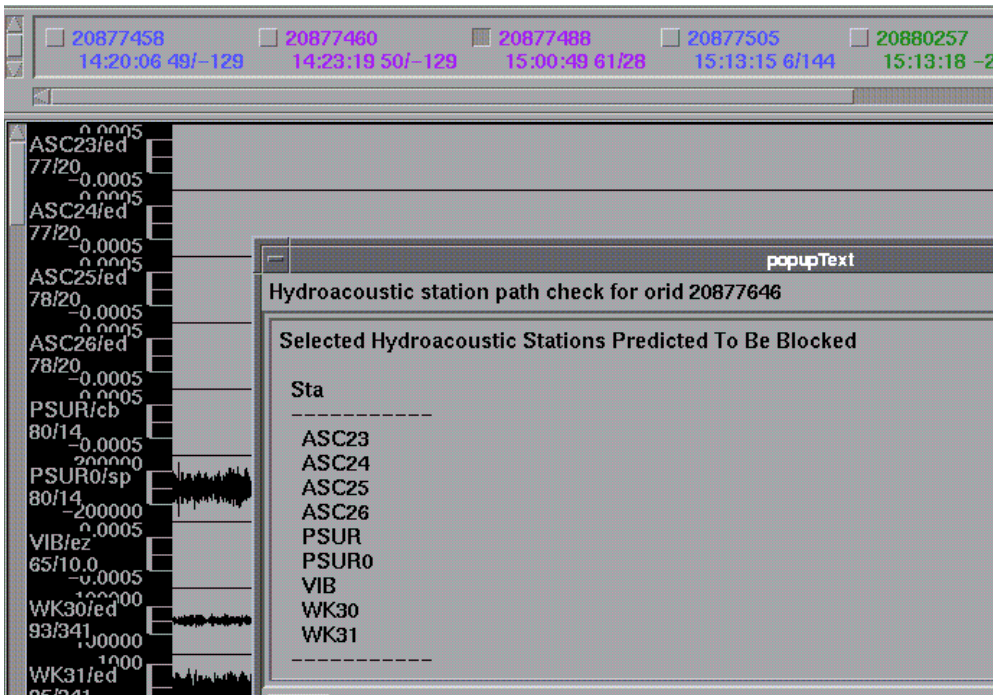


FIGURE 123. PREDICTED BLOCKAGE

Hydro > Map Hydro Path Blocked

The Map Hydro Path Blocked menu option provides the same display and warning as the Hydro Path Blocked option, but it also displays a *Map* showing the travel paths between selected stations and the event. The travel path is drawn as a great circle line between station and event. The path is drawn in red if blockage is predicted, or green if not.

To use the Map Hydro Path Blocked tool:

1. Select an event.
2. Select one or more hydroacoustic stations for which you want to check blockage.
3. Choose Hydro > Map Hydro Path Blocked.

   Map Hydro Path Blocked returns a message indicating either that no path blockage was found or that the station is predicted to be blocked. Simultaneously, *Map* is launched, which displays the paths between the selected stations and the event. You can use the map background to verify Map Hydro Path Blocked predictions.

Hydro > Select All Hydro Channels

You may choose to perform an analysis task, such as filtering or aligning, on all hydroacoustic channels at the same time. The Select All Hydro Channels menu option makes this task easier.

To select all hydroacoustic channels:

1. Choose Hydro > Select All Hydro Channels. You need not select an event; however, subsequent tasks may require a selected event.

   All hydroacoustic channels become highlighted, indicating that they have been selected.

Hydro > Add Hydro Arrival Remarks

You may need to add a comment about a specific hydroacoustic arrival. You may add a preformatted remark using the Add Hydro Arrival Remarks option. ("Edit > Remarks" on page 96 provides instructions for editing general remarks).

To add remarks to a hydroacoustic arrival:

1. Select a single arrival on a hydroacoustic station.
2. Choose Hydro > Add Hydro Arrival Remarks.

   A list of remarks appears, as shown in Figure 124.
3. Choose one appropriate comment, then click Done.

   A remark is attached to the arrival.
4. To view the remark, choose Edit > Remarks > Show Remarks on Selected, as described on page 98.

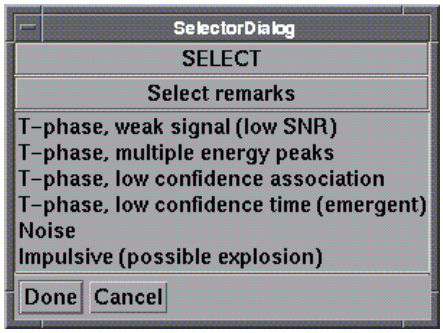


FIGURE 124. LIST OF REMARKS

Hydro > Display Hydro Arrival Group

After you have selected one hydroacoustic arrival of a group, you can use the Display Hydro Arrival Group menu option to select all members of that group. To determine if an individual arrival is a member of a hydro-arrival group, you can

view its quick-tip (see "Quick-tips" on page 37). If the quick-tip shows only the arid, then the arrival is not part of a hydro-arrival group. If the quick-tip shows azimuth information, the name of the hydro-arrival group, and the number of arrivals in the group, then it is part of a hydro-arrival group. An example of a quick-tip for a hydro-arrival group arrival is shown in Figure 125. Hydro-arrival groups are evaluated by the Automatic Processing software to calculate a group azimuth. You can examine and modify the group azimuth by using the Hydro > Send HART menu option, which is described in the next section. Selecting all members of an hydro-arrival group is useful during hydroacoustic analysis.

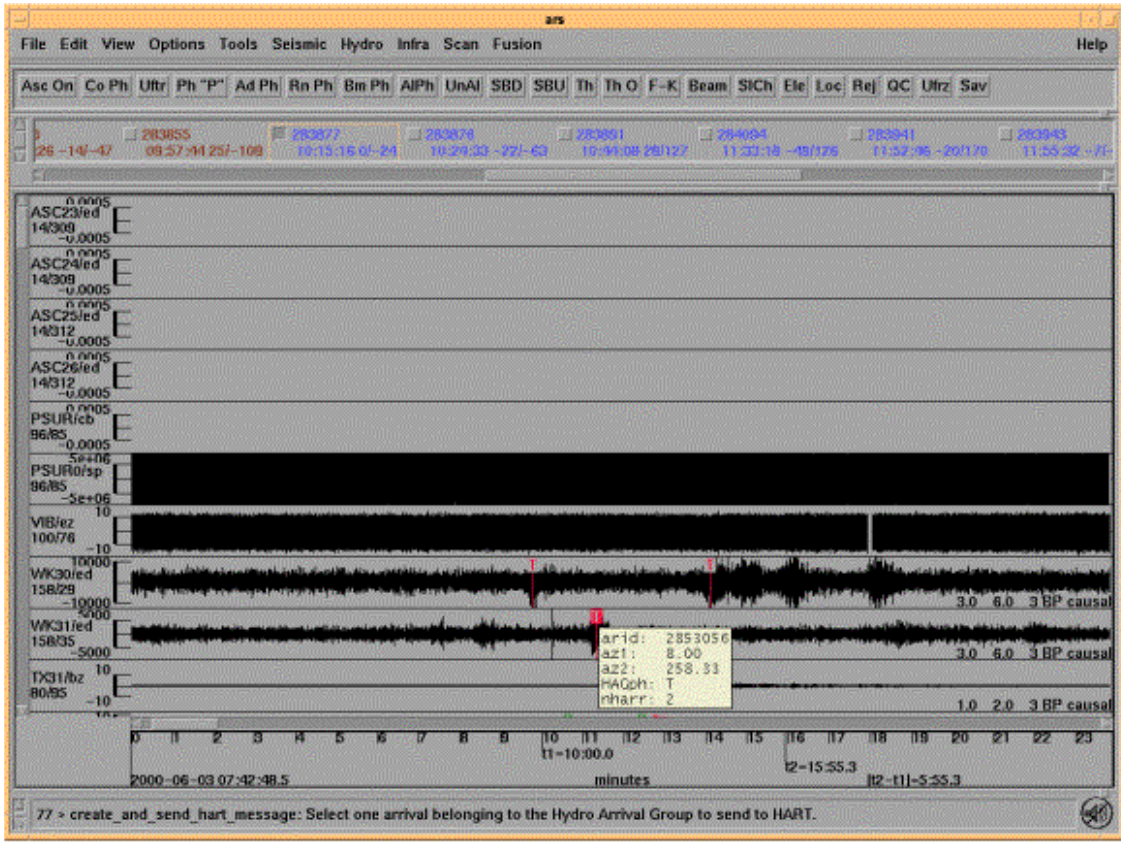

File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SlCh Ele Loc Rej QC Ufrz Sav
ASC23/ed 14/308
ASC24/ed 14/308
ASC25/ed 14/312
ASC26/ed 14/312
PSUR/cb 96/85
PSUR0/sp 96/85
VIB/ez 100/76
WK30/ed 158/29
WK31/ed 158/35
TX31/bz 80/95
arid: 2853056
az1: 8.00
az2: 258.33
HAGph: T
nharr: 2
3.0 6.0 3 BP causal
1.0 2.0 3 BP causal
t1=10:00.0
t2=15:55.3
t2-t1=5:55.3
2000-06-03 07:42:48.5
minutes
77 > create_and_send_hart_message: Select one arrival belonging to the Hydro Arrival Group to send to HART.

FIGURE 125. QUICK-TIP FOR ARRIVAL THAT BELONGS TO HYDRO-ARRIVAL GROUP

To display a hydroacoustic arrival group:

1. Select a hydroacoustic arrival belonging to a hydro-arrival group.
2. Choose Hydro > Display Hydro Arrival Group.

   All hydroacoustic arrivals belonging to the selected arrival's hydro-arrival group are selected.

Hydro > Send HART

The Hydroacoustic Azimuth Review Tool (*HART*) is an interactive tool that complements the Automatic Processing software in estimating hydroacoustic azimuth. The Send HART menu option allows you to review and edit azimuths calculated by the Automatic Processing software.

To use HART:

1. Select one arrival from a hydro-arrival group. ("Hydro > Display Hydro Arrival Group" on page 162 describes how to identify a hydro-arrival group.)
2. Filter the waveform data using one of the eight hydroacoustic frequency bands, choosing the one that displays the highest snr.
3. Perform regular analysis on the hydroacoustic arrivals (see "Hydro > DFX-Hydro Features" on page 155).
4. Zoom out to compress the waveform display so that at least 8–10 minutes of waveform data are displayed on either side of the arrival group.
5. Make certain that only one of the arrivals in the hydro-arrival group is selected, then choose Hydro > Send HART.

   HART displays all the waveforms in the hydro-arrival group on the left part of the *HART* display and the azimuth annulus and information on the right part of the display.
6. See "Hydroacoustic Azimuth Review Tool (HART) Procedures" on page 261 to continue analysis.

Infra Menu

The Infra menu provides options for enhancing review of infrasonic data. The options are listed in Figure 126.

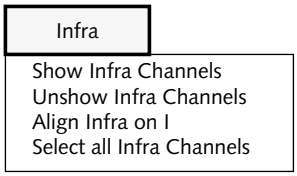


FIGURE 126. INFRA MENU

Infra > Show Infra Channels

Because the final infrasonic network will contain a large number of stations, and infrasonic analysis often requires that all station elements and beams be displayed, *ARS* is sometimes slower to respond when all of these channels are displayed. Analysts often choose to display infrasonic waveform data for short periods of time, mostly at the end of analyzing an event, to examine I phases. The Show Infra Channels menu option displays all infrasonic stations as a group at the top of the *ARS* waveform display.

To show infrasonic channels:

1. Choose Infra > Show Infra Channels. You need not select any channels.

   All infrasonic channels (usually four data channels plus beams for each station) are displayed in a group at the top of the *ARS* waveform display. If you selected an event, the infrasonic data are aligned on a theoretical I phase. The theoretical arrival time for I is positioned in the middle of the *ARS* display.

Infra > Unshow Infra Channels

The Unshow Infra Channels menu option undisplays all infrasonic channels in one operation. When analyzing one technology at a time, undisplaying infrasound data relieves you from scrolling through unnecessary data.

To undisplay infrasonic channels:

1. If infrasonic stations are displayed, choose Infra > Unshow Infra Channels. You need not select an event or channel.

   All infrasonic channels are removed from the display.

Infra > Align Infra on I

You may need to align infrasonic data, for example, after creating an event or updating an event location.

To align infrasonic channels on I:

1. Make certain that infrasonic data are displayed.
2. Choose Infra > Align Infra on I.

   The infrasonic waveforms align on the theoretical arrival time for I. The theoretical arrival time for I is positioned in the middle of the *ARS* display.

Infra > Select all Infra Channels

This option adds all infrasonic channels to the selection list.

To select all infrasonic channels:

1. Make certain that infrasonic waveform data are displayed.
2. Choose Infra > Select all Infra Channels.

   The infrasonic channels are selected.

Scan Menu

Scanning is the interactive analysis procedure used for scrolling through the waveform data to search for events missed by the Automatic Processing software. The Scan menu options shown in Figure 127 help automate parts of this process. Historically scanning has been an entirely manual process. The Scan menu contains functions that either set up the *ARS* display for scanning or perform two or more functions at a time to speed up the scanning process.

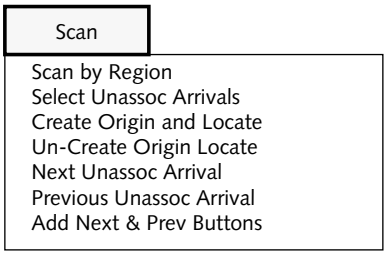


FIGURE 127.SCANNING MENU

Several of the Scan (and Fusion) menu options combine two or more functions into a single action. If you have difficulty remembering what functions the options perform, use the option's quick-tip, which provides a brief summary (see "Quick-tips" on page 37 for usage and Figure 21 for an example).

Scan > Scan By Region

You typically review one geographic region of the earth at a time while scanning for missed events. The Scan By Region menu option allows you to bring up data from stations in or near the region you want to scan (Figure 128).

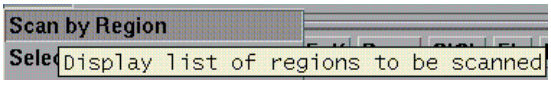


FIGURE 128.SCAN BY REGION QUICK-TIP

To scan a region:

1. Choose Scan > Scan By Region. You need not select an event or channel.

   A dialogue box appears, prompting you to select a region of the earth, as shown in Figure 129.

2. Select a region, then click Done.

   ARS displays only channels from stations for the region selected.

FIGURE 129.REGION SELECTION DIALOGUE BOX

Scan > Select Unassoc Arrivals

During scanning you may want to analyze groups of unassociated arrivals to search for evidence that some of them originate from the saved events and therefore should be associated. Examples include inspecting unassociated arrivals in *XfkDisplay* or in AlphaList. The Select Unassoc Arrivals menu option selects all unassociated arrivals (drawn in red) from all channels in the displayed time window. This includes channels that are scrolled vertically off the display. Associated arrivals and arrivals in adjacent time windows remain unselected. This option does not unselect arrivals already selected at the time of its use. Figure 130 shows the results of using this option.

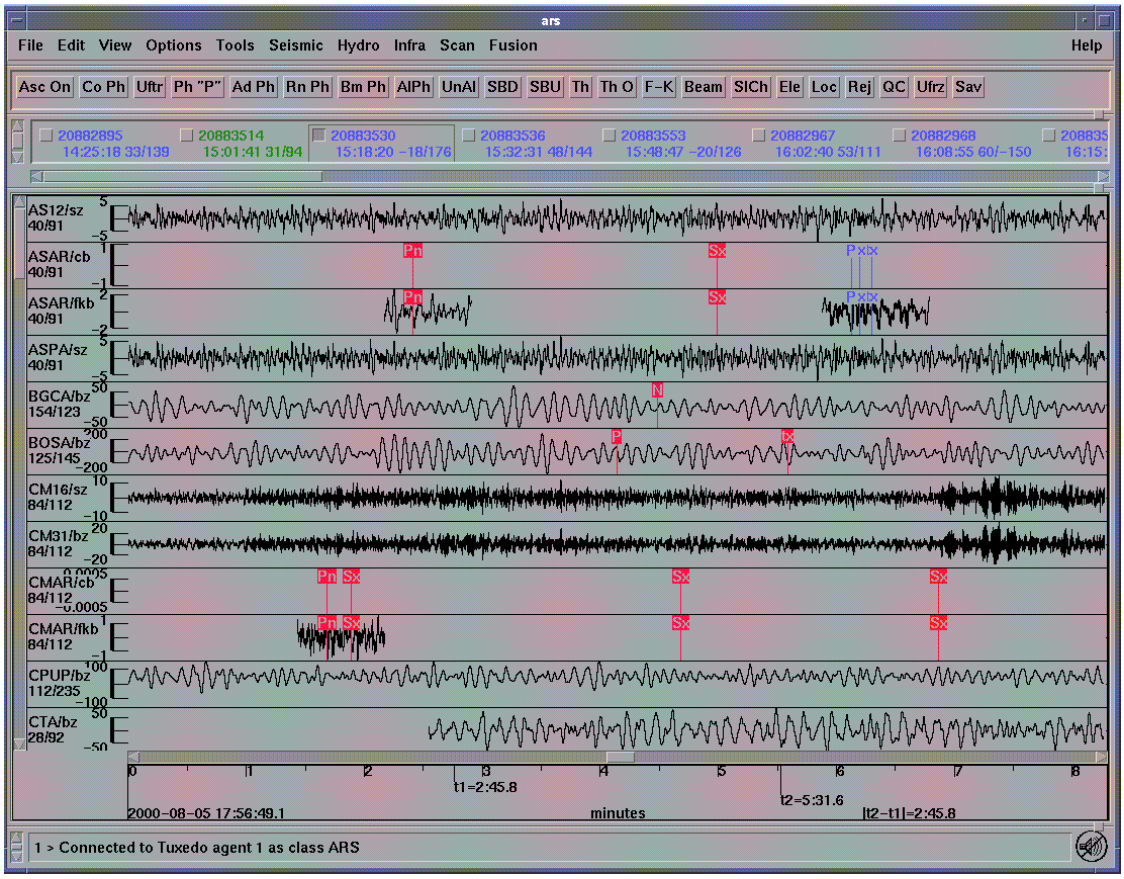


FIGURE 130. SELECTED UNASSOCIATED ARRIVALS

To select unassociated arrivals:

1. Zoom into an appropriate time window containing the desired unassociated arrivals of interest.
2. Choose Scan > Select Unassoc Arrivals.

   All unassociated arrivals in the time window are selected and become highlighted.

Scan > Create Origin & Locate

The Create Origin & Locate menu option performs a sequence of tasks. It creates a new event, places the new event on the event scroll bar, associates and displays all selected arrivals, and locates the new event using the newly associated arrivals. Figure 131 shows the quick-tip for this option.

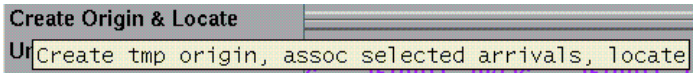


FIGURE 131. QUICK-TIP FOR CREATE ORIGIN & LOCATE

To create an origin and locate the new event:

1. Select the arrivals to be associated to the new event.
2. Choose Scan > Create Origin & Locate.

   A new event is created with a unique *evid* (event identification) and *orid* (origin identification) and placed at the end of the event scrolling list in the *ARS* window, as shown in Figure 132. If the selected arrivals are already associated to another event, they are disassociated from the old event and associated to the new event. Create Origin & Locate also locates the new event using the newly associated arrivals. AlphaList (seen in Figure 133), locator, and magnitude dialogue boxes are updated with the new information. The event information in the event scrolling list is also updated.

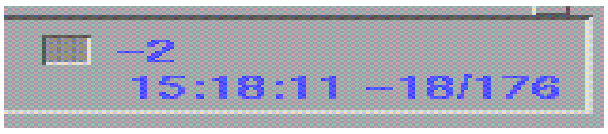


FIGURE 132. NEW ORIGIN CREATED BY CREATE ORIGIN & LOCATE

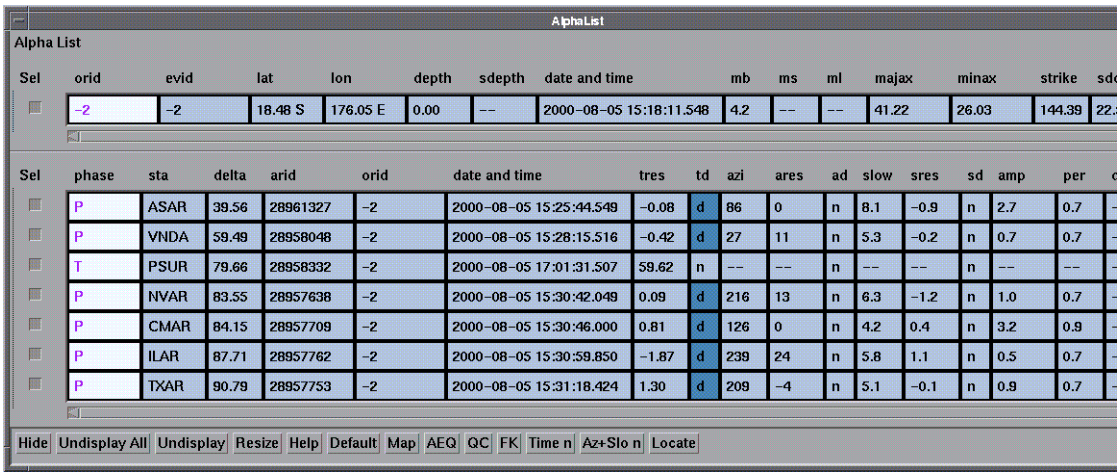


FIGURE 133. NEW EVENT IN ALPHALIST

Scan > Un-Create Origin Locate

After the analysis process leading up to Create Origin & Locate, you may want to return to the baseline scanning setup. The Un-Create Origin Locate menu option undoes the result of Create Origin & Locate and related analysis by restoring the time window, unaligning channels, deselecting all origins, restoring waveform height to 45 pixels, and displaying all detection (fk) beams.

To un-do the result of the Create Origin & Locate option:

1. Choose Scan > Un-Create Origin Locate.

   The time window is restored to the display state before Create Origin & Locate was used. The waveforms become unaligned (for example, aligned on absolute time), all origins become unselected, the waveform display height is returned to 45 pixels, and all detection beams (fkb beams) are displayed.

Scan > Next Unassoc Arrival

The Next Unassoc Arrival menu option selects and displays the closest unassociated arrival occurring later in time to the currently selected arrival, which becomes unselected. The display is scrolled as necessary to center the newly selected arrival. You have two options with this function. If a station is selected, the Next Unassoc Arrival option selects only the next arrival on that station. Without a selected station Next Unassoc Arrival selects the next unassociated arrival from all stations. Figures 134 and 135 demonstrate the results of using Next Unassoc Arrival. The selection shifts from the N phase in Figure 134 to the P phase in Figure 135.

To display the next unassociated arrival:

1. Select an unassociated arrival.
2. Choose Scan > Next Unassoc Arrival.

   The next unassociated arrival occurring later in time is selected. The *ARS* waveform display scrolls forward to center the newly selected arrival. The name and station of the selected arrival are displayed in the *ARS* message window.

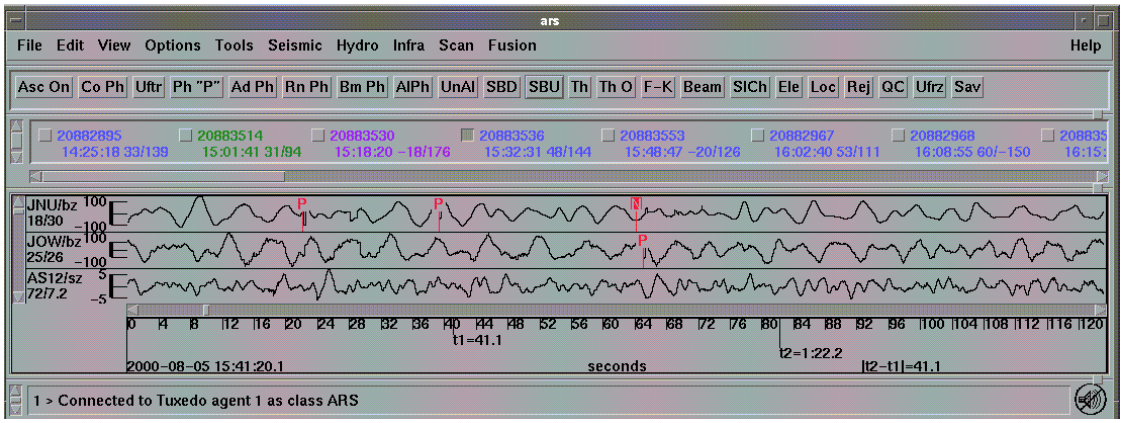

ars
File Edit View Options Tools Seismic Hydro Infra Scan Fusion Help
Asc On Co Ph Uftr Ph "P" Ad Ph Rn Ph Bm Ph AlPh UnAl SBD SBU Th Th O F-K Beam SICh Ele Loc Rej QC Ufrz Sav
20882895 14:25:18 33/139
20883514 15:01:41 31/94
20883530 15:18:20 -18/176
20883536 15:32:31 48/144
20883553 15:48:47 -20/126
20882967 16:02:40 53/111
20882968 16:08:55 60/-150
JNU/bz 18/30
JOW/bz 25/26
AS12/sz 72/7.2
t1=41.1
t2=1:22.2
2000-08-05 15:41:20.1
seconds
|t2-t1|=41.1
1 > Connected to Tuxedo agent 1 as class ARS

FIGURE 134. SELECTION BEFORE NEXT UNASSOC ARRIVAL

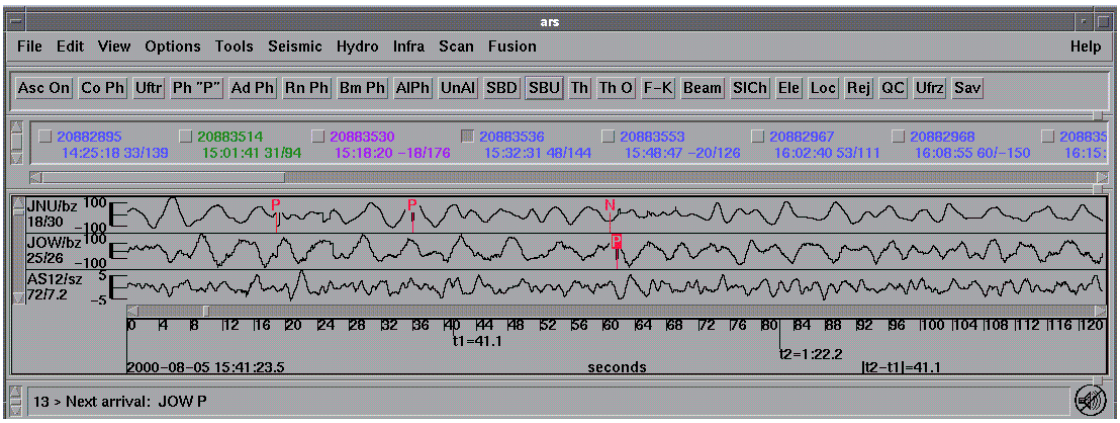


FIGURE 135. SELECTION AFTER NEXT UNASSOC ARRIVAL

Scan > Previous Unassoc Arrival

The Previous Unassoc Arrival menu option selects and displays the closest unassociated arrival occurring earlier in time to the currently selected arrival, which becomes unselected. The display is scrolled as necessary to center the newly selected arrival. You have two options with this function. If a station is selected, Previous Unassoc Arrival selects only the previous arrival on that station. Without a selected station, Previous Unassoc Arrival selects the previous unassociated arrival from all stations.

To display the previous unassociated arrival:

1. Select an unassociated arrival.
2. Choose Scan > Previous Unassoc Arrival.

   The unassociated arrival occurring earlier in time is selected. The *ARS* display scrolls backwards to center the newly selected arrival. The name and station of the selected arrival is displayed in the *ARS* message window.

Scan > Add Next & Prev Buttons

The Add Next & Prev Buttons option allows you to add toolbar buttons for the Next Unassoc Arrival and Previous Unassoc Arrival options for easier access to these options while scanning.

To add Next and Prev toolbar buttons:

1. Choose Scan > Add Next & Prev Buttons. You need not select an event or channel.

   Two new toolbar buttons, Prev and Next, appear at the right end of the toolbar, as shown in Figure 136. You may now quickly access these buttons to move between unassociated arrivals.

FIGURE 136. ADD NEXT & PREV BUTTONS

Scan > Remove Next & Prev Buttons

When you are finished with the Next (Next Unassoc Arrival) and Prev (Previous Unassoc Arrival) toolbar buttons, you can remove them from the toolbar to reduce clutter.

To remove Next and Prev toolbar buttons:

1. If the Prev and Next buttons are displayed on the toolbar, choose Scan > Remove Next & Prev Buttons.

   The Prev and Next buttons are removed from the toolbar.

Fusion Menu

The Fusion menu contains data and channel display options that apply to all three S/H/I data types, as shown in Figure 137.

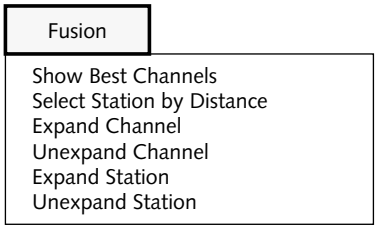


FIGURE 137. FUSION MENU

Fusion > Show Best Channels

The Show Best Channels menu option displays those stations that are most likely to detect a signal from an event based on probability of detection.

To show best channels:

1. Select an event.
2. Choose Fusion > Show Best Channels.

   Stations likely to detect a signal from the selected event are displayed sorted by distance from the event. Waveforms are filtered and aligned on the arrival time of theoretical P phase. Stations that are not likely to detect a signal are removed from the *ARS* display.

Fusion > Select Station by Distance

After using Show Best Channels or other options that remove channels from the *ARS* display, you may wish to redisplay channels. The Select Station by Distance menu option displays all stations not currently displayed, along with their distance from the event in degrees, and allows you to redisplay them.

To add stations to the *ARS* display:

1. Select an origin, then choose Fusion > Select Station by Distance.

   A list of stations not currently displayed appears, as shown in Figure 138.

2. Select one or more stations, then click Done.

   All channels that are normally displayed for the selected stations are displayed. The stations are sorted by distance from the selected event.

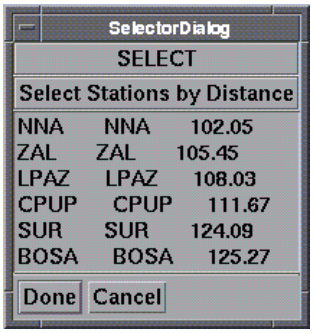


FIGURE 138. LIST OF STATIONS TO REDISPLAY

Fusion > Expand Channel

To look at more detail in a waveform, you may choose to view a single waveform. The Expand Channel menu option removes all channels from the *ARS* display except for the sole selected channel.

To expand a channel:

1. Select one channel.
2. Choose Fusion > Expand Channel. You need not select an event.

   The one selected channel fills the entire waveform display, as shown in Figure 139. All other channels are removed from the *ARS* display. If previously filtered, the waveform trace becomes unfiltered.

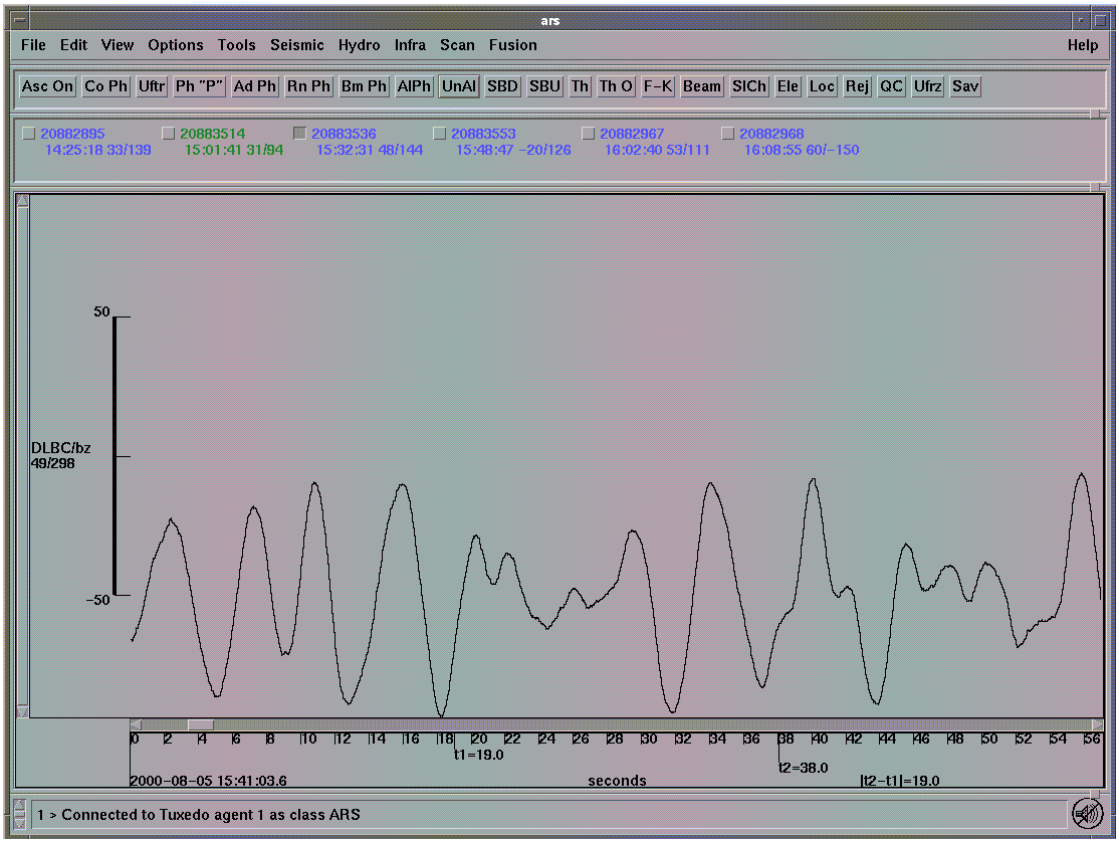


FIGURE 139. EXPAND CHANNEL DISPLAYS ONE SELECTED CHANNEL

Fusion > Unexpand Channel

The Unexpand Channel menu option can only be used after using Expand Channel. Unexpand Channel returns *ARS* to its prior display state. Channels are redisplayed in the order they were before using Expand Channel. However, all waveforms are redisplayed unfiltered.

To unexpand a channel:

1. After examining a waveform using the Expand Channel option, choose Fusion > Unexpand Channel. You need not select an event.

   Stations that were displayed prior to Expand Channel are restored to the screen, aligned and sorted as before, but unfiltered.

Fusion > Expand Station

The Expand Station menu option allows you to look at all the channels for the station of the selected channel.

To expand a station:

1. Select an event if desired.
2. Select a channel.
3. Choose Fusion > Expand Station.

   All channels or elements belonging to the station of the selected channel are displayed, as shown in Figure 140. If an event is selected, the channels are displayed, sorted by distance from the event. Channels that are added to the display are filtered with the same filter as the selected channel.

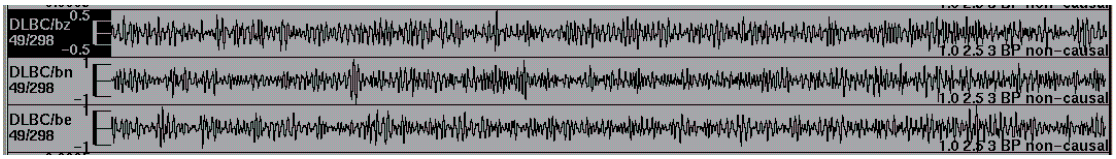


FIGURE 140. EXPAND STATION DISPLAY

Fusion > Unexpand Station

The Unexpand Station menu option can only be used after using Expand Station. Unexpand Station returns *ARS* to its prior display state. All channels added by Expand Station are removed from the display.

To unexpand a station:

1. After using Expand Station, choose Fusion > Unexpand Station.

   All channels added to the *ARS* display via Expand Station are removed. Previously displayed channels remain.

Hot Keys in ARS

Hot keys are key-key sequences that provide an efficient method of accessing menus and frequently used options through the keyboard. Table 3 describes the hot keys available in *ARS*. To use the hot keys, press the Control or Meta key while pressing the second letter key. For example, ctrl-a means press the Control key while pressing the letter a. The hot key sequences are labeled on those *ARS* menu items assigned hot keys.

TABLE 3: ARS HOT KEY FUNCTIONS

Key	Action
ctrl-a	Display AlphaList with selected event, arrivals, and channels.
ctrl-b	Display AlphaList with selected event and all associated arrivals and selected channels.
ctrl-c	Compress the waveform display (unzoom) by a factor of two.
ctrl-d	Disassociate the sole selected phase.
ctrl-e	Expand the waveform display (zoom) by a factor of one half.
ctrl-f	Display the popup filter box.
ctrl-g	Align on the selected theoretical phase (select from the popup phase list box).
ctrl-h	Display onset/termination bars for selected arrivals.
ctrl-i	Add an arrival to the sole selected channel (selected from the popup phase list box).
ctrl-j	Shift waveforms in the Waveform window to the left by 25% (show earlier time).
ctrl-k	Shift waveforms in Waveform window to the right by 25% (show later time).
ctrl-l	Locate the event.

TABLE 3: ARS HOT KEY FUNCTIONS (CONTINUED)

Key	Action
ctrl-n	Rename the selected arrival, using phase names from the popup box.
ctrl-o	Zoom on origin (window size varies).
ctrl-p	Select all channels.
ctrl-q	Select all associated arrivals.
ctrl-r	Read data.
ctrl-s	Associate the selected phases to origin.
ctrl-t	Retime the selected arrival to the t1 marker.
ctrl-u	Unzoom to previous window display.
ctrl-v	Zoom on arrival.
ctrl-w	Zoom the waveform display by a factor of 8.
ctrl-x	Compress the waveform display by a factor of 8.
ctrl-z	Zoom, using the t1 and t2 markers as zoom window limits.
Meta-j	Shift waveforms in the Waveform window to the left 50%.
Meta-k	Shift waveforms in the Waveform window to the right 50%.
Meta-x	Exit *ARS*.

AlphaList

AlphaList subwindow is an important component of interactive analysis. In a spreadsheet style format, AlphaList displays the data attributes that define events, arrivals, and stations. Some of these elements are editable from within AlphaList, such as making arrival attributes defining or non-defining. AlphaList contains a toolbar, which allows you to conveniently access some of the functionality available in the main *ARS* window. Figure 141 shows the AlphaList display.

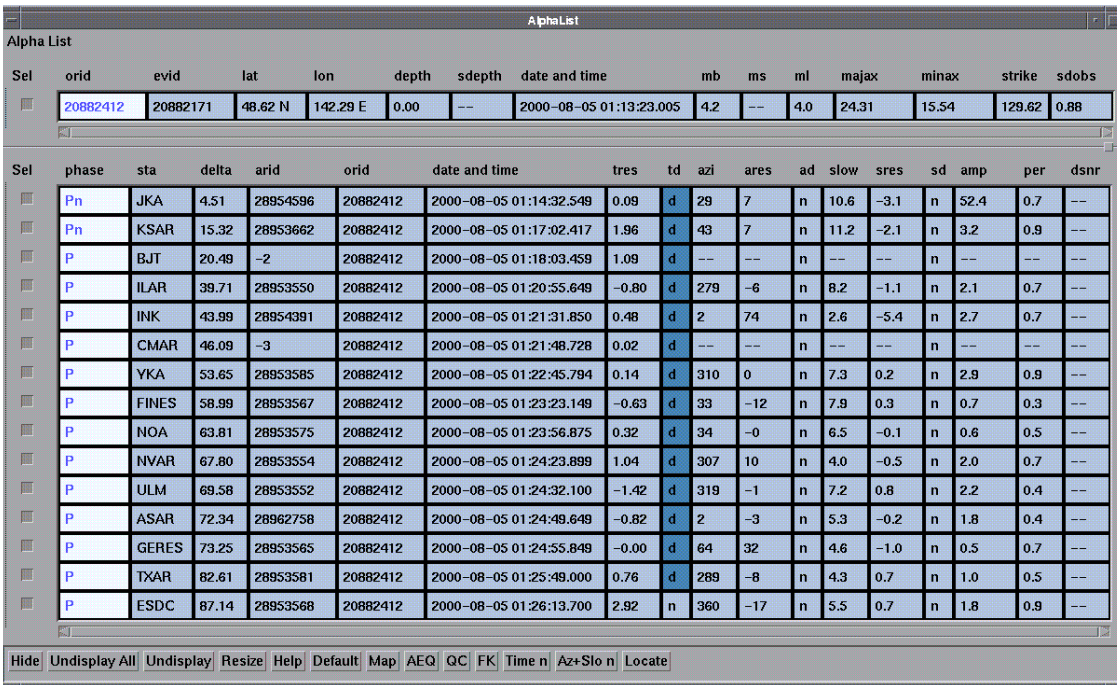


FIGURE 141. ALPHALIST

You can use several methods to display AlphaList. You can choose Edits > AlphaList > Show with Selected… to display AlphaList with all objects selected in the main *ARS* window. Or you can choose Edit > AlphaList > Show with Associated to display AlphaList with a selected event and its associated arrivals. You can also use two hot key shortcuts: ctrl-a is the same as selecting AlphaList > Show with Selected…, and ctrl-b is the same as selecting AlphaList > Show with Associated…

Like the main *ARS* window, AlphaList window is divided into several areas. The top area contains event information, the area below that contains arrival information, the next area contains channel information, and the bottom area contains a toolbar for accessing functions commonly used while analyzing events within AlphaList. Each of these areas is described in the following sections.

Event Information in AlphaList

Figure 142 shows the top area of AlphaList window, which contains event information. The columns present the data features that define an event such as its time, location, magnitude, and measures of statistical accuracy. Table 4 describes each of the fields in the event area of AlphaList. You cannot update the event fields, but these fields are updated when a new location is computed.

FIGURE 142. EVENT INFORMATION IN ALPHALIST

TABLE 4: EVENT FIELDS OF ALPHALIST

Field	Definition
Sel	Indicates if the event is selected. If pressed, the event is selected.
orid	(origin identifier) This number will change each time the event interacts with the database, for example, each time it is saved or discarded.
evid	(event identifier) This number will remain associated to the event, no matter how many times it is altered or saved and unfrozen.
lat	Latitude of the event (deg.).
lon	Longitude of the event (deg.).
depth	Depth of the event (km).
sdepth	Standard error of depth (km).
date and time	Date and time of the event.
mb	Body wave magnitude of the event.
ms	Surface wave magnitude of the event.
ml	Local magnitude of the event.

TABLE 4: EVENT FIELDS OF ALPHALIST (CONTINUED)

Field	Definition
majax	Major axis of the error elipsoid (km).
minax	Minor axis of the error elipsoid (km).
strike	The azimuth of the major axis of the error elipsoid (deg. from North).
sdobs	Standard deviation of the observation.

Arrival Information in AlphaList

Figure 143 shows the arrivals area of AlphaList window. The columns present the features that define an arrival, such as its phase, time, azimuth, slowness, and residuals. Table 5 describes each field in the arrivals area.

Sel	phase	sta	delta	arid	orid	date and time	tres	td	azi	ares	ad	slow	sres	sd	amp	per	dsnr
	Pn	JKA	4.51	28954596	20882412	2000-08-05 01:14:32.549	0.09	d	29	7	n	10.6	-3.1	n	52.4	0.7	--
	Pn	KSAR	15.32	28953662	20882412	2000-08-05 01:17:02.417	1.96	d	43	7	n	11.2	-2.1	n	3.2	0.9	--
	P	BJT	20.49	-2	20882412	2000-08-05 01:18:03.459	1.09	d	--	--	n	--	--	n	--	--	--
	P	ILAR	39.71	28953550	20882412	2000-08-05 01:20:55.649	-0.80	d	279	-6	n	8.2	-1.1	n	2.1	0.7	--
	P	INK	43.99	28954391	20882412	2000-08-05 01:21:31.850	0.48	d	2	74	n	2.6	-5.4	n	2.7	0.7	--
	P	CMAR	46.09	-3	20882412	2000-08-05 01:21:48.728	0.02	d	--	--	n	--	--	n	--	--	--
	P	YKA	53.65	28953585	20882412	2000-08-05 01:22:45.794	0.14	d	310	0	n	7.3	0.2	n	2.9	0.9	--
	P	FINES	58.99	28953567	20882412	2000-08-05 01:23:23.149	-0.63	d	33	-12	n	7.9	0.3	n	0.7	0.3	--
	P	NOA	63.81	28953575	20882412	2000-08-05 01:23:56.875	0.32	d	34	-0	n	6.5	-0.1	n	0.6	0.5	--
	P	NVAR	67.80	28953554	20882412	2000-08-05 01:24:23.899	1.04	d	307	10	n	4.0	-0.5	n	2.0	0.7	--
	P	ULM	69.58	28953552	20882412	2000-08-05 01:24:32.100	-1.42	d	319	-1	n	7.2	0.8	n	2.2	0.4	--
	P	ASAR	72.34	28962758	20882412	2000-08-05 01:24:49.649	-0.82	d	2	-3	n	5.3	-0.2	n	1.8	0.4	--
	P	GERES	73.25	28953565	20882412	2000-08-05 01:24:55.849	-0.00	d	64	32	n	4.6	-1.0	n	0.5	0.7	--
	P	TXAR	82.61	28953581	20882412	2000-08-05 01:25:49.000	0.76	d	289	-8	n	4.3	0.7	n	1.0	0.5	--
	P	ESDC	87.14	28953568	20882412	2000-08-05 01:26:13.700	2.92	n	360	-17	n	5.5	0.7	n	1.8	0.9	--

FIGURE 143. ARRIVAL INFORMATION IN ALPHALIST

TABLE 5: ARRIVAL AREA (MIDDLE AREA) OF ALPHALIST

Field	Definition
Sel	Indicates if the arrival is selected. If pressed, the arrival is selected.
phase	Phase name.
sta	Station on which the arrival is observed.
delta	Great circle distance between station and origin (deg.).
arid	Arrival identifier.
orid	Origin identifier. This number will change each time the event interacts with the database, that is each time it is saved or discarded.
date and time	Date and time that the signal is recorded at the station.
tres	The time residual from the theoretical arrival time (s).
td	Indicates whether arrival time is a defining feature for this arrival. That is, does it contribute to the event location and time. d indicates defining, n indicates non-defining.
azi	Indicates the back-azimuth (deg.) (direction from which the signal arrives at the station).
ares	Indicates azimuth residual; residual from theoretical azimuth (deg.).
ad	Indicates whether azimuth is a defining feature for this arrival. That is, does it contribute to the event location and time? d indicates defining, n indicates non-defining.
slow	Slowness (inverse velocity) of the signal (s/deg.).
sres	Slowness residual; residual from theoretical slowness (s/deg.).
sd	Indicates whether slowness is a defining feature for this arrival. That is, does it contribute to the event location and time? d indicates defining, n indicates non-defining.
amp	Measured amplitude of the signal.
per	Indicates the dominant period of signal; period of amplitude measurement (s).
dsnr	Indicates the signal-to-noise ratio for depth phase; signal ratio to 5-second noise base preceding the depth phase.

The phase type is editable, although choosing Edit > Rename is the preferrable method for changing phase type. You can edit the arrival time, azimuth, and slowness to specify whether they are defining or non-defining during computation of an event location. To edit these features, double-click the "td", "ad", or "sd" fields. A d in a field means the feature is defining or contributes to the location; n means the feature is non-defining or does not contribute to a location.

To disassociate/reassociate an arrival from/to an event, double-click in the orid field for the arrival. The field contents will toggle between a numeric origin identifier and "--" depending on whether the arrival is associated with an origin or not. Generally, fields that lack valid data are represented with a --.

Channel Information in AlphaList

Figure 144 shows the channel area of AlphaList. The columns present the features related to a channel such as its station location and full name. Table 6 describes each field in the channel area. None of the channel fields are editable.

FIGURE 144. CHANNEL INFORMATION IN ALPHALIST

TABLE 6: CHANNEL AREA OF ALPHALIST

Field	Definition
Sel	Indicates if channel is selected; if pressed, channel is selected.
sta	Station code (an acronym based on the station name).
chan	Channel type.
lat	Latitude of station (deg.).
lon	Longitude of station (deg.).

TABLE 6: CHANNEL AREA OF ALPHALIST (CONTINUED)

Field	Definition
elev	Altitude of station (km).
type	Station type.
name	Station name.

Functions in AlphaList

AlphaList contains a toolbar with buttons for the functions commonly needed for examining an event. As with the *ARS* toolbar, most of these functions also have menu option equivalents. Figure 145 shows AlphaList toolbar function buttons.

FIGURE 145. ALPHALIST TOOLBAR BUTTONS

Table 7 describes the function buttons in AlphaList toolbar.

TABLE 7: TOOLBAR FUNCTIONS IN ALPHALIST

Function	Description
Hide	Undisplays AlphaList without releasing resources.
Undisplay All	Undisplays AlphaList and releases resources.
Undisplay	Undisplays selected fields in AlphaList.
Resize	Resizes AlphaList to include all fields.
Help	Provides descriptions of the functions provided in AlphaList.
Default	Resets the location (see "Edit > Locate > Reset to Default" on page 90).
Map	Launches *Map* and displays selected events, arrivals, and/or stations (see "Tools > Map" on page 140).

TABLE 7: TOOLBAR FUNCTIONS IN ALPHALIST (CONTINUED)

Function	Description
AEQ	Provides the measure of anomalousness of an event (see "Tools > AEQ" on page 139).
QC	Performs the QC of an event (see "QC – Quality Check" on page 65)
FK	Performs azimuth and slowness computation using *XfkDisplay* (see "Tools > XfkDisplay" on page 143).
Time n	Makes time a nondefining feature for all arrivals.
Az+Slo n	Makes azimuth and slowness nondefining features for all arrivals.
Locate	Calculates an event location and the time of event.

AlphaList Hide and Undisplay All buttons, the window menu option Close and the window minimize or iconify box, do not provide the same functionality. The Hide button and the window Close menu option both remove AlphaList from the display but do not release its contents. This is very similar to iconifying a window. The window still exists, but is only displayed as an icon box. The button Hide just hides the window. The Undisplay All option releases AlphaList contents. If you use Undisplay All to undisplay AlphaList, then change the objects selected in the *ARS* window and redisplay AlphaList, you will get a new AlphaList displaying the newly selected objects. If you close AlphaList with any of the other methods, redisplaying brings back the original AlphaList with the originally selected objects. Therefore, use Hide when you will want to get back to the same AlphaList, and use Undisplay All when you want to display a new set of selections in AlphaList.

Locator Dialogue Box

The Locator dialogue box is displayed whenever a location is computed for an event. A location is successfully computed when enough defining features from associated arrivals exist to converge on an event location and time. Location and magnitude computation is documented in [IDC5.2.1]. The dialog box contains

detailed information about the event location. It allows you to refine event locations by interactively controlling some of the parameters used in the location computation.

The Locator dialogue box is shown in Figure 146. It is discussed in four parts: event solutions, history, constraints, and functions.

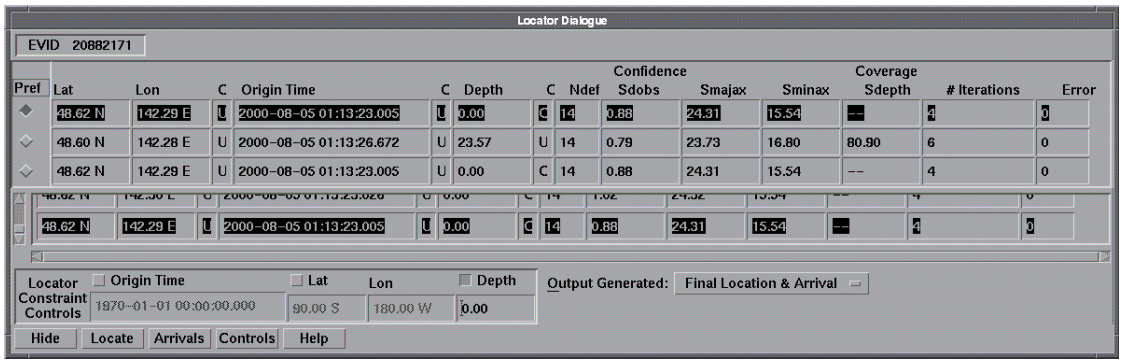


FIGURE 146. LOCATOR DIALOGUE BOX

Solutions Area of Locator

The event solutions area of the Locator dialogue box is shown in Figure 147. Table 8 describes the contents of its fields.

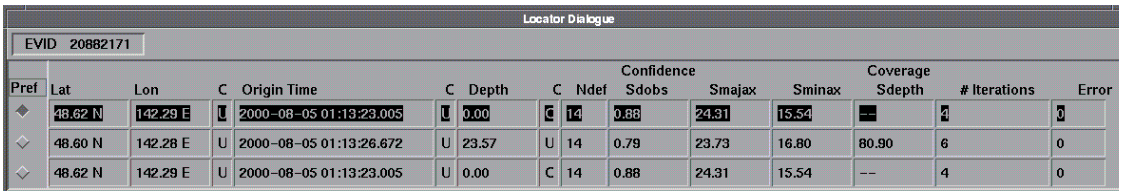


FIGURE 147. CURRENT LOCATION DISPLAYED IN LOCATOR DIALOGUE BOX

TABLE 8: FIELDS IN SOLUTIONS AREA OF LOCATOR BOX

Field	Definition
Pref	Preferred solution button (indicates/selects the preferred solution).
Lat	Latitude of event location (deg.).
Lon	Longitude of event location (deg.).
C	C = constrained, U = unconstrained location.
Depth	Depth of event (km).
C	C = constrained, U = unconstrained depth.
Ndef	Number of defining phases.
Sdobs	Standard error on location.
Smajax	Major axis on error ellipse (km).
Sminax	Minor axis on error ellipse (km).
Sdepth	Standard error on depth (km).
# Iterations	Number of iterations required before converging on a location.
Error	Reserved (presently not implemented).

Three solutions are presented in the Locator dialogue box. The top solution is the surface solution where the location is forced to the surface of the earth. The depth will always read `0 km`. The middle solution is the free-depth solution, where, if enough information exists to support it, a solution with hypocentral depth is calculated. Note the standard error on depth, which in a poor free-depth solution is often larger than the depth itself. The third solution is calculated by the Automatic Processing software and is presented as a reference. This solution may also be used to fix the depth. If you are certain of the location or depth, you may force the location or depth by typing this information in the bottom part of the Locator dialogue box. This information is updated in the third or fixed-depth solution, and you can force its use by selecting this location as the preferred solution.

Only one solution is the preferred solution. One solution has the smallest error associated with it and is automatically selected by *ARS*. You can tell which solution is preferred, because the Pref field is highlighted. You can select another preferred solution by clicking on the Pref button to indicate the desired solution. An example of needing to change the solution is when there is a possibility that the event is deep. You may not yet be certain if the event is deep, but must force the current location to a deep solution to search for depth phases. By forcing a deep solution, *ARS* aligns on phases differently than for a surface solution.

Solutions History Area of Locator

The solutions history area of the Locator dialogue box maintains a record of past location solutions, as shown in Figure 148. As you refine an event and update its location, location solutions for the current event are logged for review. The solutions history area contains the same fields as the solutions area.

FIGURE 148. LOGGING PAST LOCATIONS FOR SELECTED EVENT IN LOCATOR DIALOGUE BOX

The most current location is highlighted at the bottom of this scrolling list, which is a copy of the current preferred solution in the solutions area. This part of the display is not interactive, and a past location cannot be selected to replace a current location.

Constraint Controls Area of Locator

The constraint controls area of the Locator dialogue box allows you to fix either origin time, latitude, longitude, or depth. After adjusting constraints manually, the next location calculation is constrained accordingly.

The Output Generated: options button is also contained in this part of the Locator Dialogue Box. It specifies the level of annotation displayed in the *ARS* Scheme window.

Functions Area of Locator

The bottom part of the Locator Dialogue Box contains a set of function buttons pertinent to performing a location. Table 9 discusses the functions that are accessible through these buttons.

TABLE 9: FUNCTION BUTTONS IN LOCATOR DIALOGUE BOX

Function	Description
Hide	Undisplays the Locator dialogue box.
Locate	Calculates a location using the current set of defining data, options, and constraints.
Arrivals	Displays arrival information in a popup window.
Controls	Displays configurable locator parameters in a popup window.
Help	Provides descriptions of functions provided in the Locator dialogue box.

Locator Arrivals Popup Window

The Arrivals function in the Locator dialogue box displays a popup window with a list of all arrivals associated to the event and provides information on their defining and nondefining features, as shown in Figure 149.

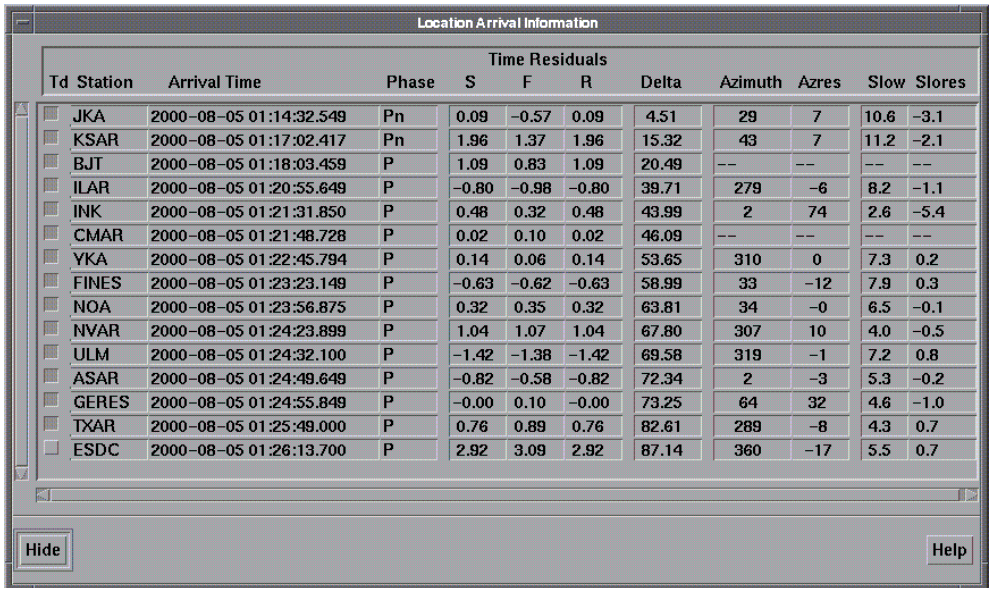


FIGURE 149. LOCATION ARRIVAL INFORMATION

Table 10 describes the list of fields in the Locator Arrivals Popup Window.

TABLE 10: LOCATION ARRIVAL INFORMATION FIELDS

Field	Description
Td	Toggle field indicating whether or not arrival is time defining.
Station	Station on which the arrival is declared.
Arrival Time	Date and time of the signal onset at the station.
Phase	Phase name.
S	Time residual for surface solutions (s).
F	Time residual for free-depth solution (s).
R	Time residual for fixed-depth solution (s).
Delta	Distance from station to the current event location (deg.).
Azimuth	An observed station to event azimuth (deg.).

TABLE 10: LOCATION ARRIVAL INFORMATION FIELDS (CONTINUED)

Field	Description
Azres	Azimuth residual, difference from theoretical (deg.).
Slow	Observed signal slowness (s/deg.).
Slores	Slowness residual, difference from theoretical.
Hide	Hides locator arrivals popup window.
Help	Provides a description of function in Locator Arrival Information

Of the location arrival information fields only the Td field is interactive. You may make an arrival time defining or non-defining by toggling the Td button beside the desired station. In Figure 149 all arrivals are defining except the arrival at station ESDC. Also, if a numeric field contains --, then no data are available for that field.

Location Controls

The Controls toolbar button displays a Location Controls window, which allows you to specify some restrictions on the location calculation and output. The window is shown in Figure 150.

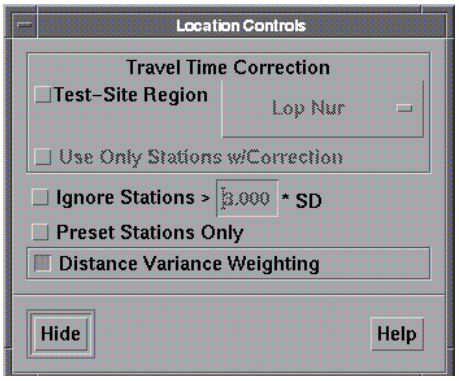


FIGURE 150. LOCATION CONTROLS BOX

The Travel Time Correction area of this window is not used by the IDC.

The Ignore Stations > *n.n* * SD option instructs *ARS* to ignore stations at distances beyond a certain multiple of the standard deviation on the location. By default this limit is turned off. If enabled, the default deviation limit is 3.0.

The Preset Stations Only option is typically disabled. This option limits the stations included in a location calculation to those listed in the Scheme cvar (variable maintained in C code and accessible by both C and Scheme) variable *locator-sub-stations-list*. The cvar variable *locator-sub-stations-only-p* controls the default setting of this field. The cvar is set to false in `ARSdefault.scm` and is not overridden in `IDC.scm`.

By default only the Distance Variance Weighting option is enabled. This option's Weighting toggle controls the usage of modeling weights.

Magnitude Dialogue Box

The Magnitude Dialogue Box contains the station and event magnitudes computed during a location computation, as shown in Figure 151. Event magnitudes and station magnitudes are calculated for the three different depth locations displayed in the Locator Dialogue Box.

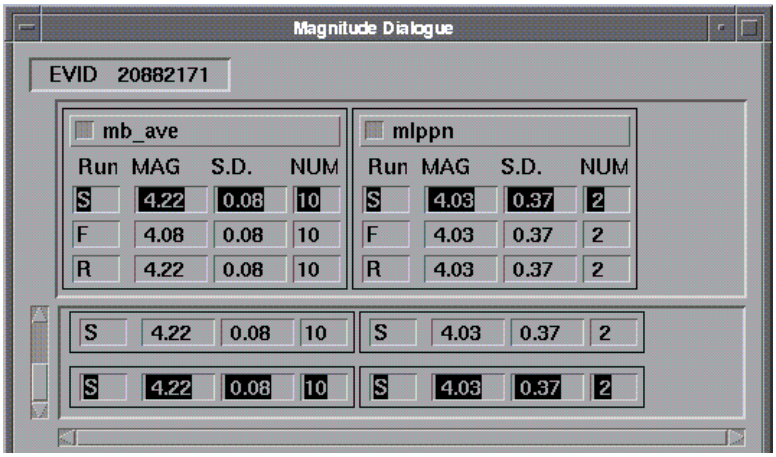


FIGURE 151. MAGNITUDE DIALOGUE BOX

The Magnitude Dialogue Box is organized much like the Locator Dialogue Box. It displays the current magnitude results and a history of previous magnitude results for the selected event. A toolbar with function buttons is located at the bottom of the display.

Figure 152 shows the portion of the Magnitude Dialogue Box that is specific to current magnitude calculation results. Table 11 describes the fields.

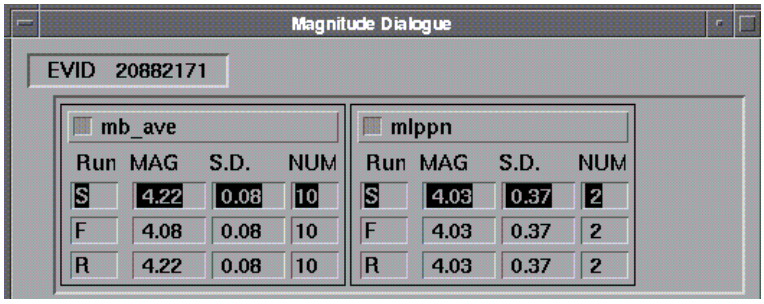


FIGURE 152. CURRENT MAGNITUDE IN MAGNITUDE DIALOGUE BOX

TABLE 11: CURRENT MAGNITUDE (TOP PART) IN MAGNITUDE BOX

Field	Description
mb_ave	Averaged body wave magnitude.
mlppn	Local magnitude calculated using local P And Pn station magnitudes.
Run	Depth solution being used (S = Surface, F = Free, R = Fixed).
MAG	Magnitude of the event.
S.D.	Standard error on magnitude.
NUM	Number of defining phases in the magnitude calculation.

The preferred solution or the solution that will be saved to the database is the same as the preferred solution highlighted in the Locator Dialogue Box. You have the option of disabling the calculation of one of the magnitudes. To do this, click either the mb_ave or ml_ppn toggle beside the appropriate magnitude label.

The second part of the Magnitude Dialogue Box is the log of past magnitude computations for the selected event (Figure 153). It contains the same fields as the current solution part of the Magnitude Dialogue Box. This area is not interactive and cannot be used to replace a current solution.

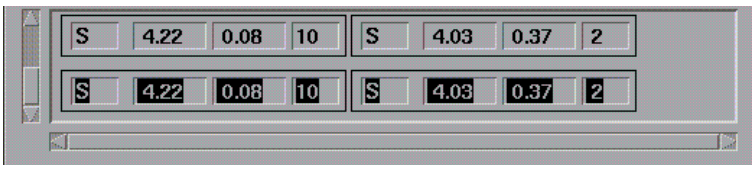


FIGURE 153.PAST MAGNITUDES LOGGED IN MAGNITUDE DIALOGUE BOX

Additional functions are provided in a button toolbar located at the bottom of the Magnitude Dialogue Box, as shown in Figure 154. Table 12 describes the functions.

FIGURE 154. FUNCTIONS IN MAGNITUDE DIALOGUE BOX

TABLE 12: MAGNITUDE DIALOGUE BOX FUNCTIONS

Function	Description
Hide	Hides Magnitude Dialogue Box.
Magnitude	Calculates new magnitude.
Arrivals	Displays arrivals and their station magnitude information.
Controls	Displays configurable parameters for magnitude computations.
Help	Displays description of functions in Magnitude Dialogue Box.

Arrivals

The Arrivals function displays a window containing the events, associated arrivals, and their amplitude/magnitude information. The column presenting the preferred solution is highlighted, as shown in Figure 155.

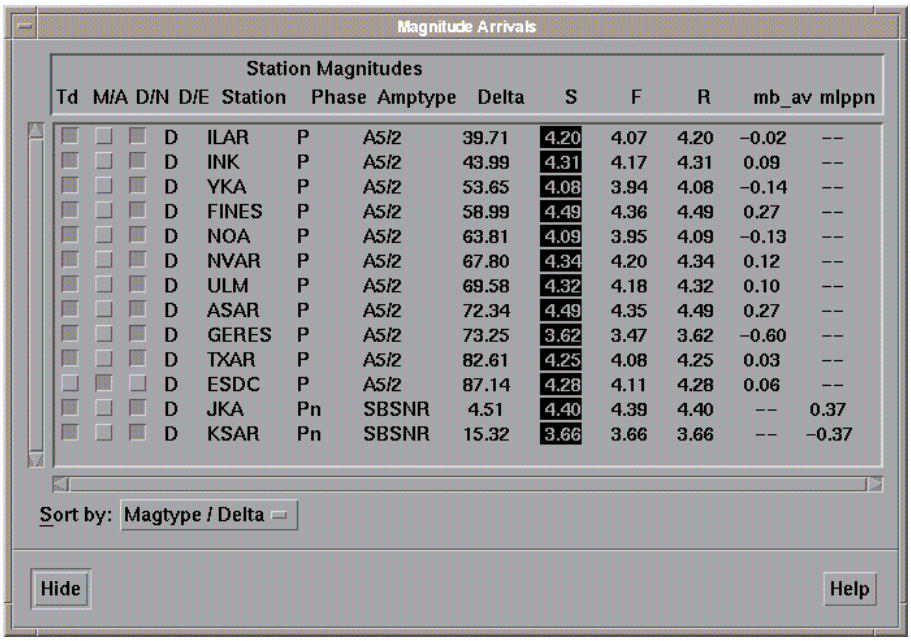


FIGURE 155. MAGNITUDE ARRIVALS WINDOW

Table 13 describes fields in the Magnitude Arrivals window.

TABLE 13: MAGNITUDE ARRIVALS BOX FIELDS

Field	Description
Td	This interactive field indicates whether or not the arrival is time defining. If pressed, the arrival time contributes to the location calculation. If not pressed, the arrival time does not.
M/A	This interactive field indicates whether the arrival's magnitude defining (D/N) state was set manually or automatically. Normally this field changes when you manually change the D/N field. If you specifically set this field to the manual state (pressed), then the current state of the D/N field, however set, becomes fixed for the next location calculation.

TABLE 13: MAGNITUDE ARRIVALS BOX FIELDS (CONTINUED)

Field	Description
D/N	This interactive field indicates whether the arrival is magnitude defining or nondefining. If pressed, the arrival is magnitude defining. If not pressed, the arrival is not magnitude defining. If you change the defining state in this field, the M/A field changes to indicate that this field was set manually, and this field becomes fixed for the next location calculation.
D/E	This field indicates whether the station magnitude calculation is detection based or event based.
Station	Station at which the arrival was observed.
Phase	Phase name.
Amptype	Amplitude type. Most commonly displayed amptypes are A5/2 for stations at teleseismic distances and SBSNR for stations at regional distances. These amptypes are described in the **ampdescript** table.
Delta	Distance of the station to the event (deg.).
S	Station magnitude calculated for the surface solution.
F	Station magnitude calculated for the free-depth solution.
R	Station magnitude calculated for the fixed-depth solution.
mb_av	Magnitude residual for m_b; the difference between station magnitude and the network averaged body wave magnitude, m_b.
mlppn	Magnitude residual for mlppn; the difference between station magnitude and the network averaged local magnitude, mlppn.
Sort by:	Options for displaying arrival information. The arrivals can either be displayed and sorted by Magnitude Type or Delta (distance of the station from the event).
Hide	Hide the Magnitude Arrivals window.
Help	Present a description of the functions in the Magnitude Arrivals window.

Magnitude Controls

The Controls button displays a window providing some options to control the magnitude calculation. The Controls window is shown in Figure 156. The most commonly used limits are the Ignore Stations > *n.n* * SD and the ability to alter the minimum and maximum distance of stations used for the magnitude calculation.

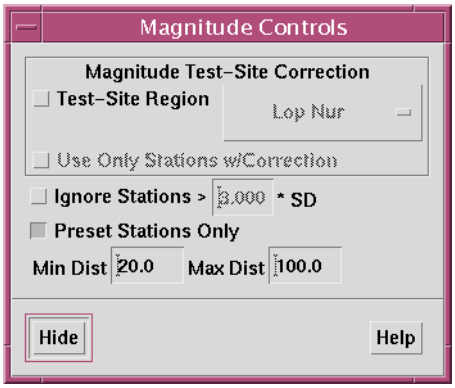


FIGURE 156. MAGNITUDE CONTROLS WINDOW

The Magnitude Test-Site Correction area is not used at the IDC.

If you select Ignore Stations, *ARS* ignores stations with distances beyond a certain multiple of the standard deviation of the location calculation. By default this limit is turned off. If enabled, the default deviation value is 3.0.

The Preset Stations Only field is typically enabled (pressed). This limits the stations included in a magnitude calculation to those listed in the Scheme cvar variable *magnitude-sub-stations-list*, specified in `IDC.scm`. The next fields specify the minimum and maximum distance of stations whose P and Pn phases are to be included in the magnitude calculation. The default is set to a minimum distance of 20.0 degrees and a maximum distance of 100.0 degrees.

DESCRIPTIONS OF ADDITIONAL ANALYST TOOLS

The tools described in the remaining areas of Chapter 2 support and enhance the capability provided in *ARS*. These tools were introduced in the *ARS* area "Tools Menu" on page 138.

XFKDISPLAY PROCEDURES

XfkDisplay is an interactive application that computes an arrival's azimuth and slowness using data from either arrays or 3-C stations. It presents a color-coded projection of signal strength computed with respect to the north-south and east-west components of slowness. Station-to-event azimuth is derived from the coordinates of peak energy. Using this tool you can assess the quality of the signal, for example, to determine if the signal's azimuth compares favorably with a theoretical event location or if the measured slowness of an arrival is compatible with its designated phase type. Because of its ability to separate and distinguish signal energy in different areas of the slowness plane, *XfkDisplay* is particularly helpful in mixed event situations, that is cases where the signal energy from different events are recorded at a station at about the same time.

XfkDisplay works by performing a frequency-wavenumber (f-k) analysis for array stations or by polarization analysis at 3-C stations. The algorithms for these analyses are given in [IDC5.2.1]. From this analysis, azimuth and slowness are presented to you for interactive review in the form of a tabular display and an interactive GUI. *XfkDisplay* takes its name from frequency (F) wavenumber (K) spectrum, and the *XfkDisplay* plot is referred to as the FK plot. FK is a misnomer when applied to the analysis of 3-C stations. Although the data presentation is the same, the data are generated by different means.

XfkDisplay Window Layout and Organization

Figure 157 shows the main *XfkDisplay* window with its menu bar, tool bar, arrival list, and message area. While Figure 157 shows only one arrival, *XfkDisplay* can handle multiple arrivals; the arrival list becomes scrollable when the number of arrivals exceed the window limits. A number of parameters are displayed for each arrival including results and statistics for the FK analysis. Table 14 describes the fields in the *XfkDisplay* arrival list.

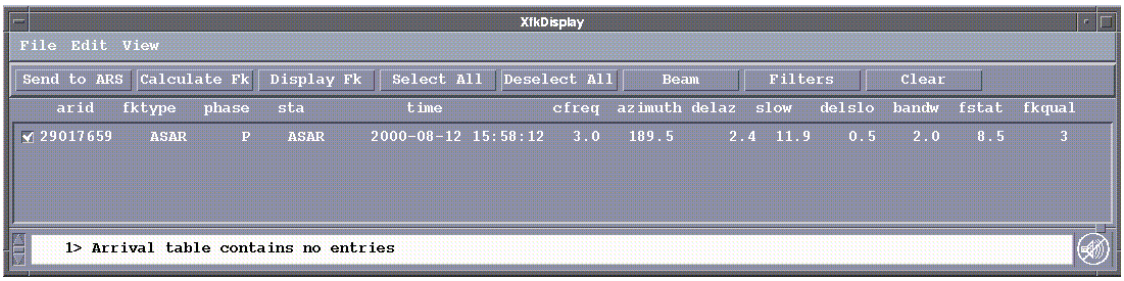


FIGURE 157. MAIN XFKDISPLAY WINDOW

TABLE 14: XFKDISPLAY FIELDS

Field	Description
selection checkbox	Arrivals can be selected or deselected. When an arrival is selected, a checkmark appears. When an arrival is not selected, the checkmark is not present. To select or deselect, click once with the left mouse button.
arid	Arrival identifier.
fktype	Reference name for recipe parameter set (default is station name).
phase	Phase name.
sta	Station being used.
time	Arrival time.
cfreq	Center frequency (Hz).

TABLE 14: XFKDISPLAY FIELDS (CONTINUED)

Field	Description
azimuth	Observed station-to-event azimuth (deg. east of north).
delaz	Azimuth uncertainty (deg.).
slow	Slowness (s/deg., inverse of velocity).
delslo	Slowness uncertainty (s/deg.).
bandw	Band width (Hz).
fstat	Degree of signal coherence across the array.
fkqual	Fk quality.

Error and warning messages appear at the bottom of the main *XfkDisplay* window. The small bell icon on the bottom right of the window controls sound from the tool. To turn the alert beeps off, click directly on the bell. A vertical line will be drawn through the bell. To turn the beep back on, click it again.

FK plot

When an arrival is sent from *ARS* to *XfkDisplay*, a tabular entry of the arrival's attributes is added to the arrival list in the main *XfkDisplay* window. A separate FK plot window is displayed with a graphical representation of the arrival's FK spectrum (or incidence angle analysis for 3-C stations). The FK plot window also contains tabular arrival attributes. Figure 158 shows the entire FK window, and Figure 159 shows just the FK plot.

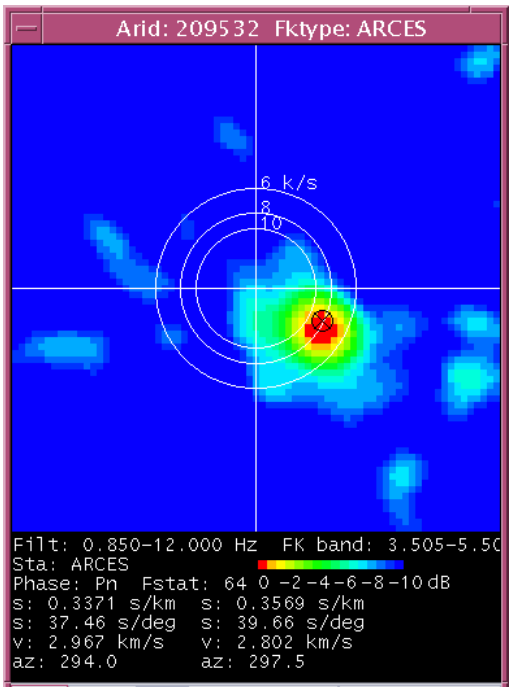

Arid: 209532 Fktype: ARCES
6 k/s
8
10
Filt: 0.850-12.000 Hz FK band: 3.505-5.5
Sta: ARCES
Phase: Pn Fstat: 64 0 -2 -4 -6 -8 -10 dB
s: 0.3371 s/km s: 0.3569 s/km
s: 37.46 s/deg s: 39.66 s/deg
v: 2.967 km/s v: 2.802 km/s
az: 294.0 az: 297.5

FIGURE 158.XFXDISPLAY FK PLOT WINDOW

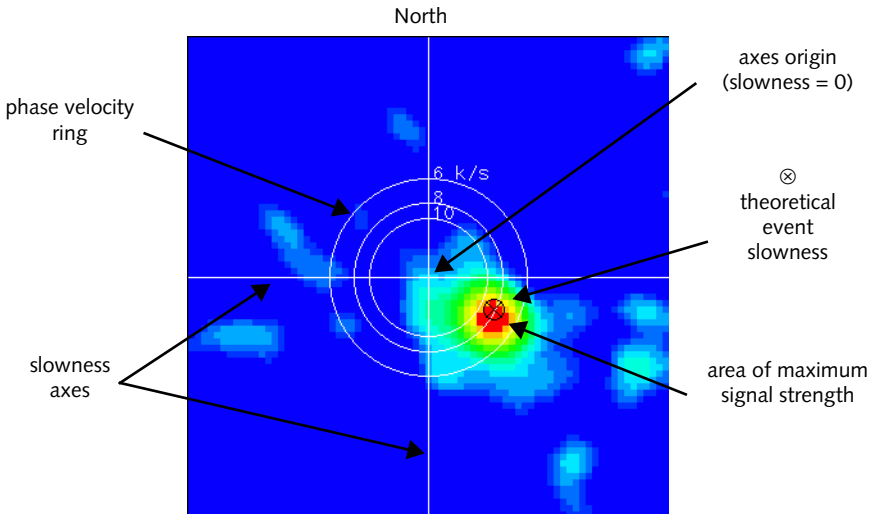


FIGURE 159. GRAPHICAL SECTION OF FK PLOT

The FK plot in Figure 159 is presented as a slowness plane. The horizontal and vertical axes represent the north-south and east-west components of slowness with North at the top of the plot. Slowness decreases towards the middle of the display (meaning that velocity increases) and increases towards the edges of the display (meaning that velocity decreases). Circles of equal slowness radiate from the center of the plot. Azimuth quadrants and circles of constant velocity are drawn for reference. Slowness, velocity, and station-to-event azimuth values are listed below the plot. A theoretical slowness based on the *ARS*-computed location of the event selected in *ARS* is represented on the plot by a ⊗ symbol.

The color scheme in the FK plot is based on computed signal power. The area on the slowness plane with the highest computed power appears in red. Levels decrease from this peak in the order of orange, yellow, green, and finally blue. Figure 159 presents an example of an arrival whose signal power appears to originate from a bearing of approximately 122 degrees azimuth with a slowness of approximately 15 seconds/degree or equivalently an apparent velocity of 8 km/s.

The plot can be thought of abstractly as viewing the station or array from directly above. For seismic data, a peak in the middle area of the FK plot represents signal wavefronts striking the array nearly parallel to the earth's surface. A peak along the edges of the FK plot represents wavefronts striking at a significant angle to the earth's surface. An array station measures the apparent horizontal components of velocity as the wavefront sweeps across the elements of the array.

Consider a seismic event that occurs at great teleseismic distance from an array. It would deliver core phase signal energy essentially straight up to the array, and the signal's wavefront would be detected nearly simultaneously at all station elements. This would imply a very high apparent horizontal velocity; the FK slowness would approach zero. The signal energy peak in the FK plot would occur at the axes origin. It follows that as the slowness approaches zero the azimuth becomes indeterminate. For events located closer to the array the apparent horizontal velocity decreases and the slowness increases. For a teleseismic P phase the signal energy peak would occur inside the "10" circle, for a regional P phase it would occur between the "6" and "8" circles, and a regional S phase peak would occur outside all circles.

For array stations, *XfkDisplay* computes an FK spectrum power value for each grid point in the FK plot. The power is computed by summing the complex valued spectra computed from each array element's waveform. For each grid point, the spectra have been phase shifted[1] to account for that grid point's view of the geographical coordinates of the station's elements. Each grid point can be thought of as a different test case in phase shifting the waveforms. Grid points show the highest signal power when phase shifting yields the highest signal coherence among the array elements. This shows up as a peak on the plot. The azimuth of the peak represents the direction towards the incoming wavefront.

1. Phase shifting in the frequency domain is analogous to time shifting waveforms and is computationally more efficient. The time shift must remain small relative to the waveform duration converted into the frequency domain. Such is the case with the small differences in arrival times across the elements of an array.

3-C stations measure particle motion or signal amplitude along three orthogonal axes. A station-specific signal velocity is used to derive slowness from the measured incidence angle. Each grid point in the *XfkDisplay* plot represents a different incidence angle. The grid points in the neighborhood of the incidence angle of maximum 3-C amplitude have the highest signal power and show up as a peak on the plot. The position of the peak represents the direction of the greatest rectilinearity and so it is applicable where the signal's particle motion is parallel to its direction of propagation such as for P-waves.

Ideally each signal detected by an array would generate one sharp peak in the FK plot, leaving little ambiguity about where the signal energy is concentrated, and making the azimuth and slowness easy to interpret. However, in practice analysts often have to investigate further to pinpoint the correct azimuth and slowness values for the arrival. In addition to theoretical limits of resolution, data errors, missing channel data, noise within a signal, mismatch between the FK processing band and the signal's spectrum, or signals from mixed sources are all reasons why an FK result may be ambiguous. In difficult cases you can review the event location and the signal energy in the waveform data, and adjust the FK processing band to deduce the true azimuth and slowness. See "Filters" on page 223 to adjust the FK processing band.

Besides the graphical representation of the *XfkDisplay* output, the FK plot window also displays the output numerically, as shown in Figure 160.

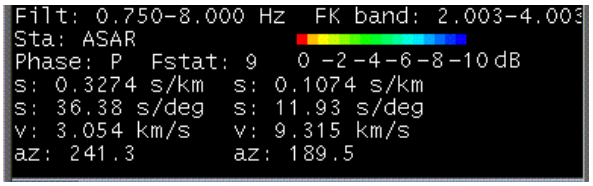

Filt: 0.750-8.000 Hz FK band: 2.003-4.003
Sta: ASAR
Phase: P Fstat: 9 0 -2 -4 -6 -8 -10 dB
s: 0.3274 s/km s: 0.1074 s/km
s: 36.38 s/deg s: 11.93 s/deg
v: 3.054 km/s v: 9.315 km/s
az: 241.3 az: 189.5

FIGURE 160. NUMERICAL OUTPUT OF XFKDISPLAY

The color bar is the legend relating color to signal power, where red represents the highest power and blue represents the lowest power. The right column displays the azimuth and slowness at the peak signal power in the FK plot. The left column displays azimuth and slowness at the position of the cursor. Table 15 describes the fields in the FK plot's tabular output.

TABLE 15: FK PLOT TABULAR OUTPUT

Field	Description
Filt	Bandpass of data prefilter.
FK band	Frequency band used in the FK computation.
Sta	Station name.
Phase	Phase name.
Fstat	F-statistic.
s (left column)	Slowness at cursor position (s/km and s/deg.).
s (right column)	Slowness at signal peak (s/km and s/deg.).
v (left column)	Velocity at cursor position (km/s).
v (right column)	Velocity at signal peak (km/s).
az (left column)	Azimuth at cursor position (deg.).
az (right column)	Azimuth at signal peak (deg.).

The left column in the FK plot window updates in response to mouse movement in the FK plot area. To update in this manner:

1. Move the cursor within the FK plot.

   The values in the left column change to reflect the position of the cursor in the azimuth/slowness (FK) plot area.

If you suspect that *XfkDisplay* has misidentified the correct peak (for example, due to spatial aliasing, high noise, or a mixed event), select another peak.

2. Select an azimuth/slowness point by clicking within the FK plot.

   The values for this point are transferred to the right column of the numerical display on the plot, replacing the *XfkDisplay* preferred result.

The bottom part of the FK plot window provides buttons for functions relevant to the FK plot (Figure 161).

FIGURE 161. FUNCTION BUTTONS IN FK PLOT WINDOW

The Done button removes the FK plot window from the display. The tabular list entry for the arrival remains in the main *XfkDisplay* window.

The Apply button transfers the preferred azimuth/slowness values from the FK plot window to the main *XfkDisplay* window, replacing the original preferred values selected by *XfkDisplay*. From there the values can be sent to *ARS*.

To apply new values:

1. Select an azimuth/slowness point by clicking within the FK plot.

   The values for this point are displayed in the right column of the FK plot window.

2. To transfer the values to the main *XfkDisplay*, click Apply.

   The arrival's attributes are updated in the main *XfkDisplay* window.

The last two buttons restore the correct aspect ratio of the FK plot after you manually resize the window. The FK plot will likely become skewed when resizing. The Square Width button resizes the width to fit the height, and the Square Height button resizes the height to fit the width.

To resize the width of the FK plot window to fit the height:

1. Resize the FK window.

2. If the phase velocity rings become skewed, click Square Width.

   The window width adjusts to a correct aspect ratio for the current height. The phase velocity rings become circles again.

Main Menu Functions

The main menus and toolbar options allow you to modify to *XfkDisplay* results and to allow *XfkDisplay* to interact with *ARS* (see Figure 162).

FIGURE 162. MENU AND TOOLBAR OPTIONS IN XFKDISPLAY

File Menu

The File menu provides one option, Exit, as shown in Figure 163.

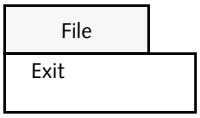


FIGURE 163. FILE MENU IN XFKDISPLAY

File > Exit

To exit *XfkDisplay:*

1. Choose File > Exit.

   The *XfkDisplay* program exits.

Edit Menu

The Edit menu provides options to edit parameter settings and manipulate data objects (Figure 164).

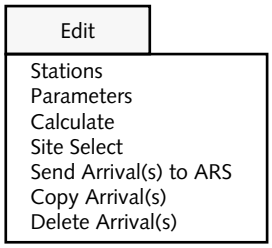


FIGURE 164. EDIT MENU IN XFKDISPLAY

Edit > Stations

The Stations option allows you to edit station-specific parameters used by *XfkDisplay* to compute azimuth and slowness. System defaults for these parameter values are specified in parameter files, which *XfkDisplay* reads on startup. The *XfkDisplay* man page provides details on all station parameters that you can set interactively.

To edit station-specific parameters:

1. Choose Edit > Stations.

   A list of stations is displayed, as shown in Figure 165.

2. Select the station whose parameters require editing.

   A parameter editing window is displayed, as shown in Figure 166.

3. Edit the appropriate fields, then click Apply.

XfkDisplay uses these new station-specific parameters in its future calculations. Parameter changes are lost when *XfkDisplay* exits.

Clicking Cancel disregards any changes made in the parameter editing window. When you are finished editing parameters, close the station selection window by clicking Dismiss in that window.

FIGURE 165. STATION SELECTION WINDOW

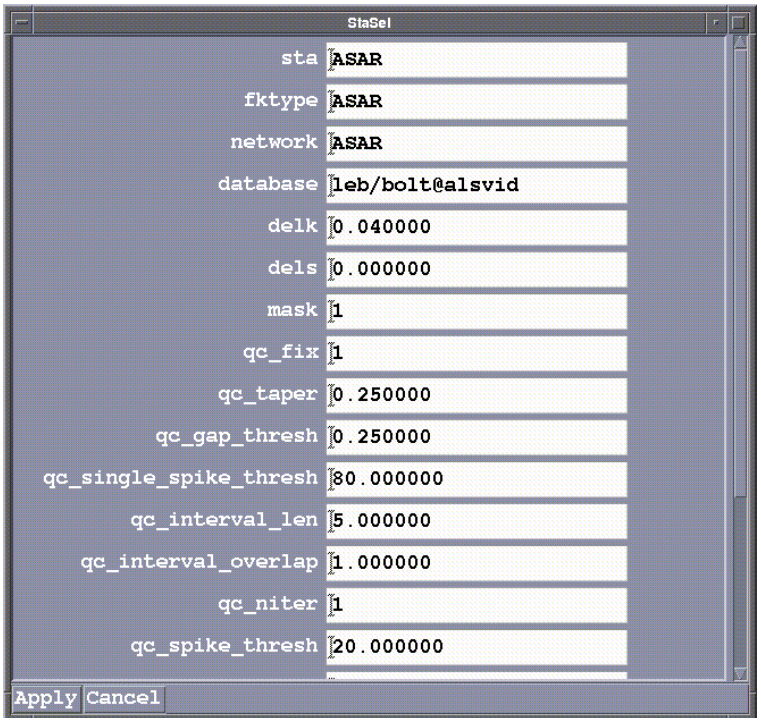


FIGURE 166. STATION-SPECIFIC PARAMETER WINDOW

Edit > Parameters

XfkDisplay uses a set recipe when performing a calculation. Recipes are referenced from the Edit > Stations parameters by the fktype entry. The Parameters option allows you to edit the recipe parameters used by *XfkDisplay* to compute azimuth and slowness. System defaults for these parameter values are specified in parameter files, which *XfkDisplay* reads on startup. The *XfkDisplay* man page provides details on all recipe parameters that you can set interactively.

Changing the fktype parameter renames the recipe, and the original name is lost. If the Edit > Stations fktype reference is not found, the FK computation fails. Also, you cannot reset a recipe back to its original values.

To edit recipe parameters:

1. Choose Edit > Parameters.

   A station selection window is displayed.

2. Select the station whose recipe parameters require editing.

   A parameter editing window opens, as shown in Figure 167.

3. Make changes to the values presented in this window, then click Apply.

   XfkDisplay uses the new parameters in its future calculations. Any changes made to the recipe parameters are lost when *XfkDisplay* exits.

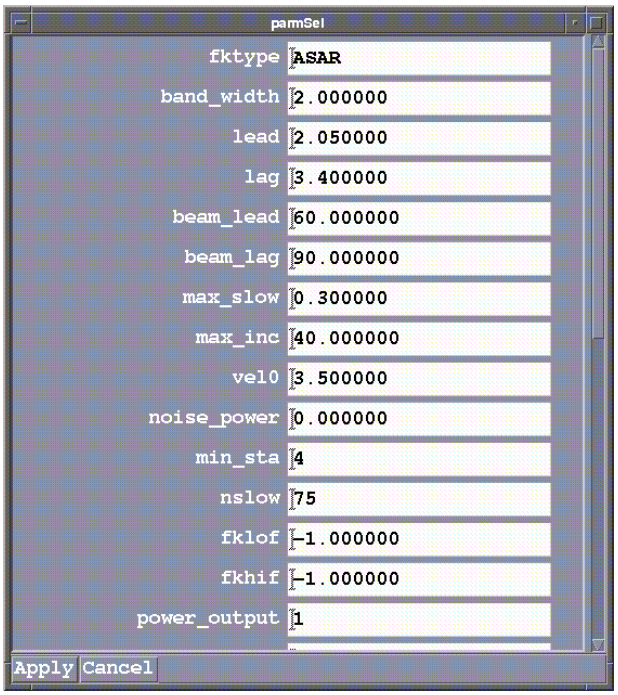


FIGURE 167. RECIPE PARAMETER WINDOW

Clicking Cancel disregards the changes. When finished editing recipe parameters, you can undisplay the stations selection list by clicking Dismiss at the bottom of the station selection list.

Edit > Calculate

The Calculate option performs an azimuth/slowness calculation on all selected stations. This calculation updates the *XfkDisplay* output and has the same function as Calculate FK on the toolbar. Calculate is automatically called each time a new arrival is sent from *ARS*.

To update the azimuth/slowness calculation:

1. In the *XfkDisplay* window, make sure the arrival to be recomputed is selected (see the Select option in Table 14 on page 202). If necessary, adjust the filter or the parameter files (see "Filters" on page 223 or the *XfkDisplay* option "Edit > Stations" on page 211 and "Edit > Parameters" on page 213).
2. Choose Edit > Calculate.

   XfkDisplay updates its calculation for the selected arrival. Azimuth, slowness, and F-statistic are recomputed, and all fields, including residuals, are adjusted accordingly.

Edit > Site Select

Occasionally, you may notice bad data on a specific channel, either by observing it in the waveform data or through station quality reports. Bad data can distort the results of an *XfkDisplay* calculation. You can remove one or more array station channels from the *XfkDisplay* processing (Figure 168).

FIGURE 168. CHANNEL LIST IN XFKDISPLAY WITH ALL CHANNELS SELECTED

To remove one or more channels from *XfkDisplay* processing for the current analysis session:

1. Choose Edit > Site Select.

   A station selection window, similar to Figure 166 on page 213, is displayed.

2. Select the desired station.

   A list of channels for that station is displayed, as shown in Figure 168. By default, all channels are selected, as indicated by the check mark beside each channel.

3. To deselect one or more channels, click the check. To reselect a channel, click the checkbox again.

4. To apply the channel selection changes, click Apply. To ignore changes, click Cancel.

   The deselected channels are excluded from *XfkDisplay* processing for the rest of the current analysis session. Any beaming and azimuth/slowness computations are processed without data from the deselected channels.

Edit > Send Arrival(s) to ARS

If you have made changes to the output of *XfkDisplay* and have computed azimuth and slowness values that are to be used in *ARS* for a proper event location, these data need to be sent to *ARS*. The azimuth and slowness information for one or more arrivals in the *XfkDisplay* window can be copied to *ARS* by the Send Arrival(s) to *ARS* option.

To send arrivals to *ARS*:

1. Make the necessary changes to the azimuth and slowness in *XfkDisplay*. Make sure the arrival is selected.
2. Choose Edit > Send Arrival(s) to *ARS*.

   The azimuth and slowness information calculated in *XfkDisplay* is transferred to the arrival's parameters in *ARS*, replacing the previous azimuth and slowness. You can view the updated parameters in AlphaList. Figures 169 and 170 show a section of AlphaList before and after updating arrival parameters from *XfkDisplay*; note the changed azimuth and slowness values.

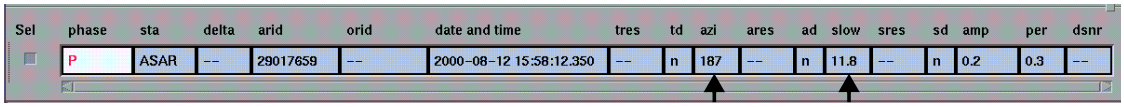

Sel phase sta delta arid orid date and time tres td azi ares ad slow sres sd amp per dsnr
P ASAR -- 29017659 -- 2000-08-12 15:58:12.350 -- n 187 -- n 11.8 -- n 0.2 0.3 --

FIGURE 169.ARS ALPHALIST BEFORE XFKDISPLAY UPDATE

Sel phase sta delta arid orid date and time tres td azi ares ad slow sres sd amp per dsnr
P ASAR -- 29017659 -- 2000-08-12 15:58:12.350 -- n 201 -- n 11.9 -- n 0.2 0.3 --

FIGURE 170.ARS ALPHALIST AFTER XFKDISPLAY UPDATE

Edit > Copy Arrival(s)

The Copy Arrival(s) option allows you to analyze and compare the same arrival using more than one FK recipe. Copy Arrival(s) creates a second arrival entry with the same arid, but references the FK recipe specified by the fktype parameter from the arrival's Edit > Stations parameter set. If the fktype reference has been changed the copied arrival uses a different FK recipe, and the original remains unchanged.

The fktype reference in Edit > Stations names an FK recipe from the list of available Edit > Parameters sets. By default the fktype is set to the station name so all these names match. You cannot create new Edit > Parameters sets, but you can edit existing ones. The safest approach is to edit the parameter set named "default" and then change fktype in the arrival's Edit > Stations parameter set to default. You can edit the parameter set with the fktype of the station and even change the fktype name; however, the original parameter set will be lost and cannot be retrieved. (See "Edit > Stations" on page 211 and "Edit > Parameters" on page 213.)

To copy arrivals:

1. Choose Edit > Parameters.
2. Select the default parameter set from the bottom of the parameter set selection list.
3. Edit the recipe parameters as necessary.
4. Click Apply to save the edits.
5. Click Edit > Stations.
6. Choose the arrival's station from the station selection list.
7. Edit the fktype parameter to specify `default` as the recipe name.
8. Click Apply in the parameter edit window.

9. Choose Edit > Copy Arrival(s).

   A new arrival entry appears in the arrivals list. This arrival has the same arid as the original arrival and uses the default fktype. You can now analyze the new arrival entry and make modifications to the default parameter set as necessary to compare it with the original arrival entry's FK recipe.

Be sure to set the station's fktype back to the original name before sending new arrivals on that station from *ARS*, else the new arrivals will also reference the default fktype.

Edit > Delete Arrival(s)

The Delete Arrival(s) option deletes selected arrivals from the *XfkDisplay* window. Deleting the arrivals means that they are no longer available for FK processing. Typically, you delete an arrival when you have completed analysis of it.

To delete arrival(s):

1. Select only those arrival(s) in *XfkDisplay* window targeted for deletion. All arrivals are set selected when initially received by *XfkDisplay*.
2. Choose Edit > Delete Arrival(s).

   The selected arrival(s) are removed from the *XfkDisplay* window. The selected arrival(s) FK plot windows remain and must be individually dismissed.

View Menu

The View menu provides two display options for the FK plot, as shown in Figure 171.

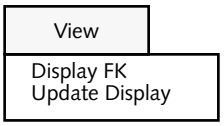


FIGURE 171.XFKDISPLAY VIEW MENU

View > Display Fk

When you make adjustments to filters or parameters and re-compute an FK result by choosing either Calculate Fk or Calculate from the Edit menu, *XfkDisplay* does not automatically redisplay a dismissed FK plot. The Display Fk option redisplays the FK plot.

To redisplay the Fk plot:

1. Select one or more arrivals.
2. Choose View > Display Fk.

   FK plot windows are displayed for all selected arrivals. Duplicate FK plots are produced for selected arrivals already displaying an FK plot.

View > Update Display

The Update Display option updates an arrival's FK plot to reflect a new FK calculation. For example, if you adjust an FK recipe and then use Calculate FK, you can use Update Display to update the FK plot with the new information.

To update the Fk plot:

1. If a new FK is calculated for a selected arrival and its FK plot window is already displayed, choose View > Update Display.

   The displayed FK plot is updated to display the new FK calculation for the arrival.

Toolbar

XfkDisplay provides a number of toolbar function buttons for options frequently accessed during routine analysis. These buttons are shown in Figure 162 on page 210.

Send to ARS

The Send to ARS function is the same as Edit > Send Arrival(s) to *ARS*.

Calculate Fk

The Calculate Fk function is the same as Edit > Calculate.

Display Fk

The Display Fk function is the same as View > Display Fk.

Select All

The Select All function sets all arrivals in *XfkDisplay* to a selected state.

To select all arrivals:

1. Click Select All for the *XfkDisplay* toolbar.

   All arrivals display a checkmark beside them, indicating a selected status.

Deselect All

The Deselect All function sets all arrivals in *XfkDisplay* to a deselected state.

To deselect all arrivals:

1. Click Deselect All from the *XfkDisplay* toolbar.

   Checkboxes beside each arrival become unchecked, indicating an unselected status.

Beam

XfkDisplay can create a beamed waveform segment for display in *ARS*. *XfkDisplay* delays and sums together all the array channel waveform segments for a specific time interval surrounding the arrival. This function has the effect of enhancing the snr in the waveform.

Unlike origin beams, FK beams or detection beams are calculated based on the arrival's measured azimuth and slowness rather than the azimuth toward an origin location. You produce an FK beam to optimize snr when the origin beam is not optimal, for example, when dealing with a poor event location.

To create a beam:

1. Select the arrival to be beamed. Click Beam from the *XfkDisplay* toolbar.

   A temporary FK or detection beam is computed and sent to *ARS*. The waveform segment appears in the *ARS* waveform display sorted by distance from the selected event and aligned on the current default phase. The first FK beam produced for that station using *XfkDisplay* is identified as `fkb-00` as shown in Figure 172. If additional beams are produced for that station, they are be labeled as `fkb-01`, and so forth. When you exit the *ARS* session, temporary FK beams are discarded.

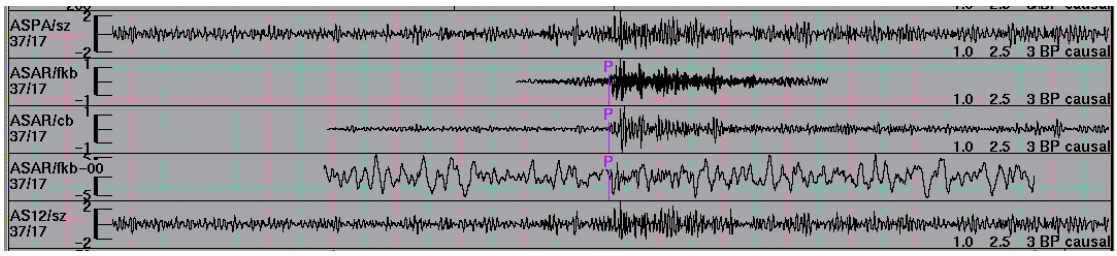


FIGURE 172. ARS AFTER FK BEAM IS RECEIVED FROM XFKDISPLAY

Filters

To help improve the FK result you can adjust the frequency band used during the FK calculation. Just as applying a filter to a waveform trace can enhance the signal in the chosen frequency bands, applying a filter to the FK calculation can enhance the energy peak in the FK plot. If you do not specifically apply a filter, a default filter is used.

The filter selected with this function is applied during the FK calculation to set the boundaries for converting waveforms to frequency domain. A prefilter is applied to the time domain waveforms prior to the FK analysis. This function also adjusts the prefilter settings to be slightly wider than the selected FK band. All these filter settings are set in the FK recipe parameters list specified by the selected arrival's fktype (see "Edit > Parameters" on page 213). The FK band is specified in the *fklof* and *fkhif* fields, and the prefilter is specified in the *flo* and *fhi* fields. If the Edit > Parameters window is displayed when the Filters option is used, you will see these fields being updated. You can adjust them independently by directly setting them in the Edit > Parameters window. To compare two filter settings on the same arrival, use the method described in "Edit > Copy Arrival(s)" on page 218.

To apply a filter to an Fk calculation:

1. Click Filters from the *XfkDisplay* toolbar.

   A list of filters appears as shown in Figure 173.

2. Select one filter band from the list, preferably one that best matches the frequency content of the signal. Alternatively, you can enter the cutoff values into the *fklof* and *fkhif* fields below the filter list.

3. Click Apply to choose the new filter. You can also click Reset to use the default filter. When you have chosen a filter, click Calculate FK from the *XfkDisplay* toolbar to recompute the FK using the new filter.

   XfkDisplay recomputes the FK using the new filter and returns a numerical result. Click Display FK to see the revised FK plot. The tabular annotation in the FK plot window lists both the waveform filter and the FK band used during the FK calculation.

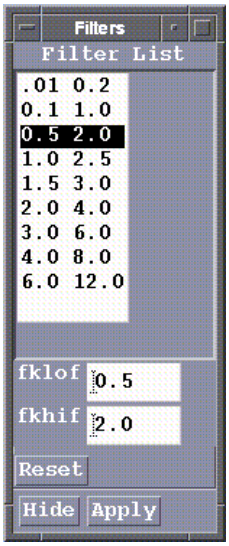


FIGURE 173. FILTER DISPLAY IN XFKDISPLAY

Clear

The Clear function in the *XfkDisplay* toolbar removes all arrivals from the *XfkDisplay* main window and dismisses all FK plot windows.

To clear arrivals:

1. With arrivals in the *XfkDisplay*, click Clear in the Xfk toolbar.

   All arrival data are removed from *XfkDisplay*.

MAP PROCEDURES

Map is a two-dimensional, interactive, graphical display of the earth that you can use to visualize the location of events and contributing stations. *Map* displays the oceans and major land masses at a default scale of 1:20 million. *Map* provides a number of different display features, including a display of the location of all the events currently under analysis in *ARS*, or a drawing of the travel paths for individual phases. You can limit the view to certain geographic areas, display all the historical events from high or low seismicity areas, or select specialized maps on which to work. You can display latitude and longitude as a grid for reference and adjust the color to distinguish the features.

Map Window Layout and Organization

Figure 174 shows the *Map* display with its default settings. The land mass appears in a brown color (shaded for topography), and the ocean and other bodies of water appear in blue (shaded for depth). *Map* is displayed at a scale of 1:20 million, with historical events plotted in small dots. (The red dots in this figure indicate shallow seismicity). A black color has been used to plot an event and its error ellipse (see "Tools > Map" on page 140 for selecting the colors of objects sent from *ARS*). In Figure 174 *Map* is automatically centered on the location of the event that was sent from *ARS*.

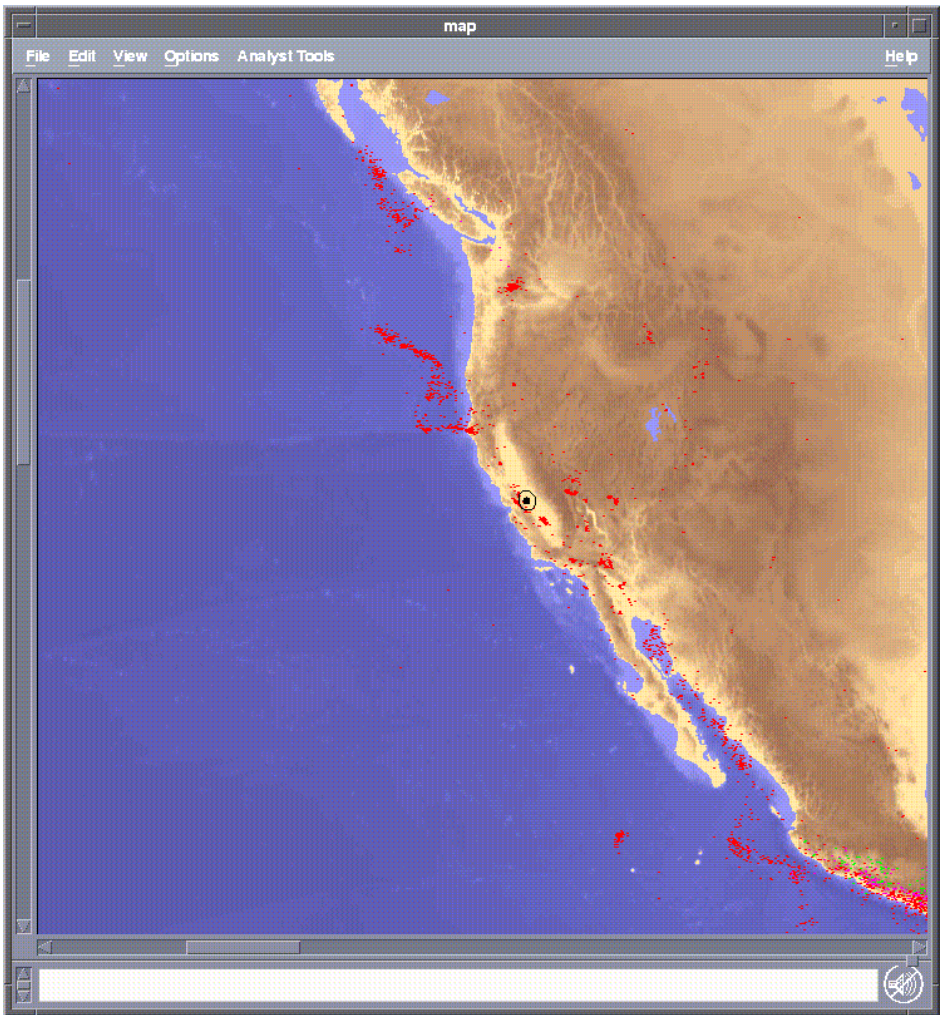


FIGURE 174. DEFAULT MAP DISPLAY

The following sections describe interactive features of *Map*.

File Menu

The File menu provides two options: New Database… and the Exit option, as shown in Figure 175.

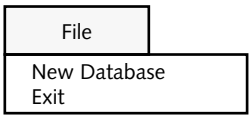


FIGURE 175. FILE MENU IN MAP

File > New Database

The New Database option allows you to manually connect to a different database. On startup, *Map* connects to the database specified in the environment variable *$Map_DATABASE*. The startup database provides map-specific initialization data.

To make some of the database queries provided under the Edit menu, you must connect to a different database, because the database referenced in *$Map_DATABASE* does not contain tables such as **site** or **origin**.

File > Exit

The Exit option quits the *Map* session. An alternative method is provided by "Stopping Applications in dman" on page 306.

To exit *Map*:

1. Choose File > Exit.

Map and its Scheme window disappear.

Edit Menu

The Edit menu provides options for manipulating display objects in *Map, as* shown in Figure 176.

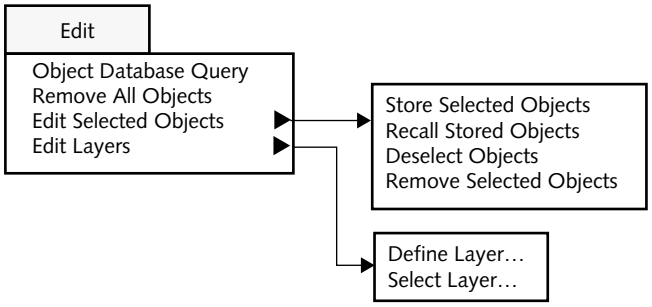


FIGURE 176.EDIT MENU IN MAP

Edit > Object Database Query

After you have connected to an appropriate database (see "File > New Database" on page 227) you can construct queries for the mappable objects, arrivals, origins, originorigerrs, and sites. The menu option for each object expands to a submenu that provides options for creating and executing queries, shown in Figure 177.

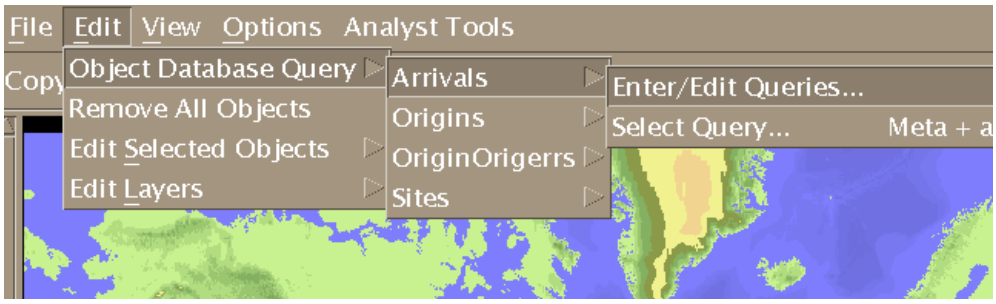


FIGURE 177.OBJECT DATABASE QUERY OPTIONS

To construct a query:

1. Choose Edit > Object Database Query > (an object) > Enter/Edit Queries.

   A query entry dialogue window is displayed.

2. Enter a query in the Enter > Edit queries field for origin, for example, "where mb > 4.0".
3. Choose Edit > Select Query to execute that query. You can enter complex queries in the edit fields.

   All origins with mb > 4.0 are plotted. Objects are always plotted in red.

Edit > Remove All Objects

The Remove All Objects option clears the *Map* display. Any drawn objects, such as events and stations, that are not part of the standard *Map* background upon startup, are removed.

To remove plotted objects:

1. Choose Edit > Remove All Objects.

   The *Map* display is cleared to show the standard *Map* background.

Edit > Edit Selected Objects

The Edit Selected Objects option contains the functions that allow you to store, remove, and recall selected objects plotted on the *Map* display, as shown in Figure 178.

FIGURE 178. EDIT SELECTED OBJECTS OPTIONS IN MAP

To select an object, click the left mouse button on the object when the cursor crosshairs are over it. You can repeat this action to select additional objects. The selected objects turn black.

The Edit > Edit Selected Objects > Store Selected Objects submenu option saves the selected object in the memory buffer. Then the Edit > Edit Selected Objects > Recall Stored Objects submenu option recalls the stored objects, returning them to the display. Storing new objects replaces any objects previously stored.

The Deselect Objects submenu option deselects any objects currently selected in the *Map* display. The Edit > Edit Selected Objects > Remove Selected Objects submenu option removes any selected objects from the *Map* display.

To remove a selection of objects from the *Map* display:

1. Use the left mouse button to click the objects to be removed.
2. Choose Edit > Edit Selected Objects > Remove Selected Objects.

   The selected objects are removed from the *Map* display.

Edit > Edit Layers

Layers provide a means of grouping objects drawn on the *Map*. When *Map* is first displayed a default layer is created; this is the layer on which you plot objects (events, phases, and so forth) until you create another layer. You can stack layers grouping different objects on top of each other, and change the ordering of layers. The Edit Layers options are shown in Figure 179.

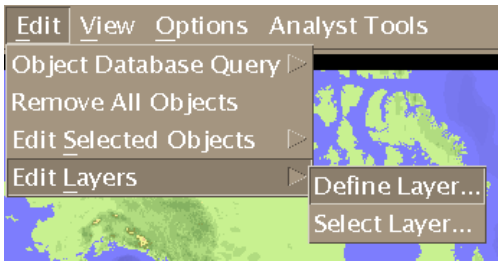


FIGURE 179. EDIT LAYERS OPTIONS IN MAP

You can add layers by using the Edit > Edit Layers > Define Layer… option. The dialogue box allows you to add a named, new layer on top of the current layer. Anything drawn in *Map* is drawn on this layer and belongs to it. Objects are always drawn and manipulated on the current layer. To make another layer current choose the Edit > Edit Layers > Select Layer… submenu option, and enter the desired layer's name.

View Menu

The View menu in *Map* provides display options including Zooming, changing *Map* views, and *Map* outlines, as shown in Figure 180.

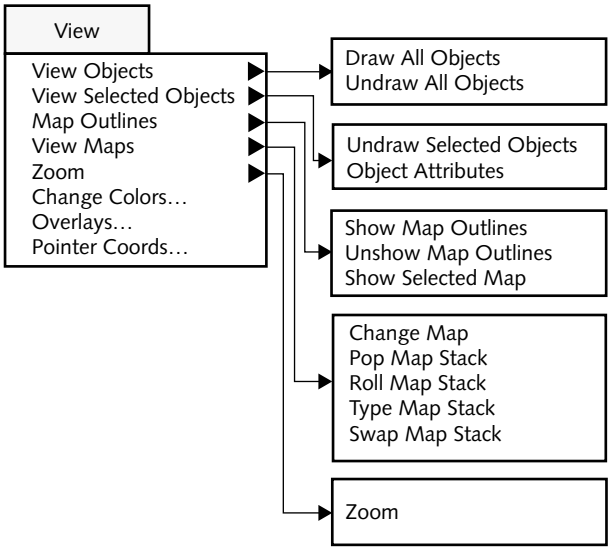


FIGURE 180. VIEW MENU IN MAP

View > View Objects

The View Objects submenu shown in Figure 181 provides options that undisplay and redisplay objects without permanently deleting them; they remain present in *Map* memory. (To permanently delete objects, use the options in *Map's* Edit menu.)

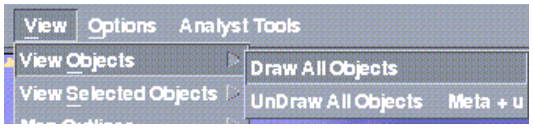


FIGURE 181. VIEW OBJECTS OPTION IN MAP

To temporarily remove objects from the display:

1. Choose View > View Objects > UnDraw All Objects.

To restore the objects to the display:

1. Choose View > View Objects > Draw All Objects.

   The objects reappear.

View > View Selected Objects

The options in the View Selected Objects submenu allow you to access and manipulate individual objects in *Map*, as shown in Figure 182.

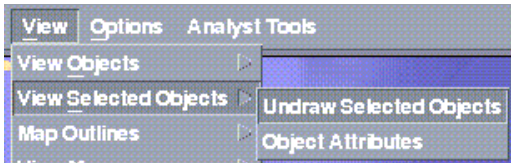


FIGURE 182. VIEW SELECTED OBJECTS OPTION IN MAP

To temporarily hide one or more selected objects from the display:

1. Select the objects (events, phases, and so forth).

2. Choose View > View Selected Objects > Undraw Selected Objects.

   The objects are removed from the display.

   Object Attributes displays a dialogue box containing attribute information for one or more selected arrivals. If more than one object is selected before selecting Object Attributes, then a separate dialogue box is displayed for each, superimposed one on top of each other.

To see object attributes from *Map*:

1. Select those objects (events, phases, and so forth) from the map.
2. Choose View > View Selected Objects > Object Attributes.

   The attribute information of each selected object is displayed in separate dialogue boxes.

View > Map Outlines

Map outlines are the boundaries of available map projections. Maps of a number of specific geographic regions are available (for example, one map outline surrounds the North Polar region). The menu options are shown in Figure 183.

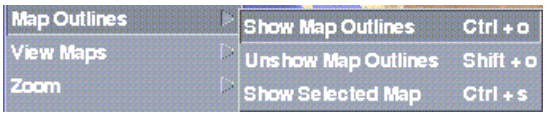


FIGURE 183. MAP OUTLINES OPTIONS IN MAP

View > Map Outlines > Show Map Outlines

The Show Map Outlines option displays the current map view with all the possible map outlines available. *Map* outlines are best displayed using a world map, as shown in Figure 184.

To display a view of all map outlines available in *Map*:

1. Choose View > Map Outlines > Show Map Outlines.

   An outline of all map views available in the *Map* program is displayed, superimposed upon the current map view.

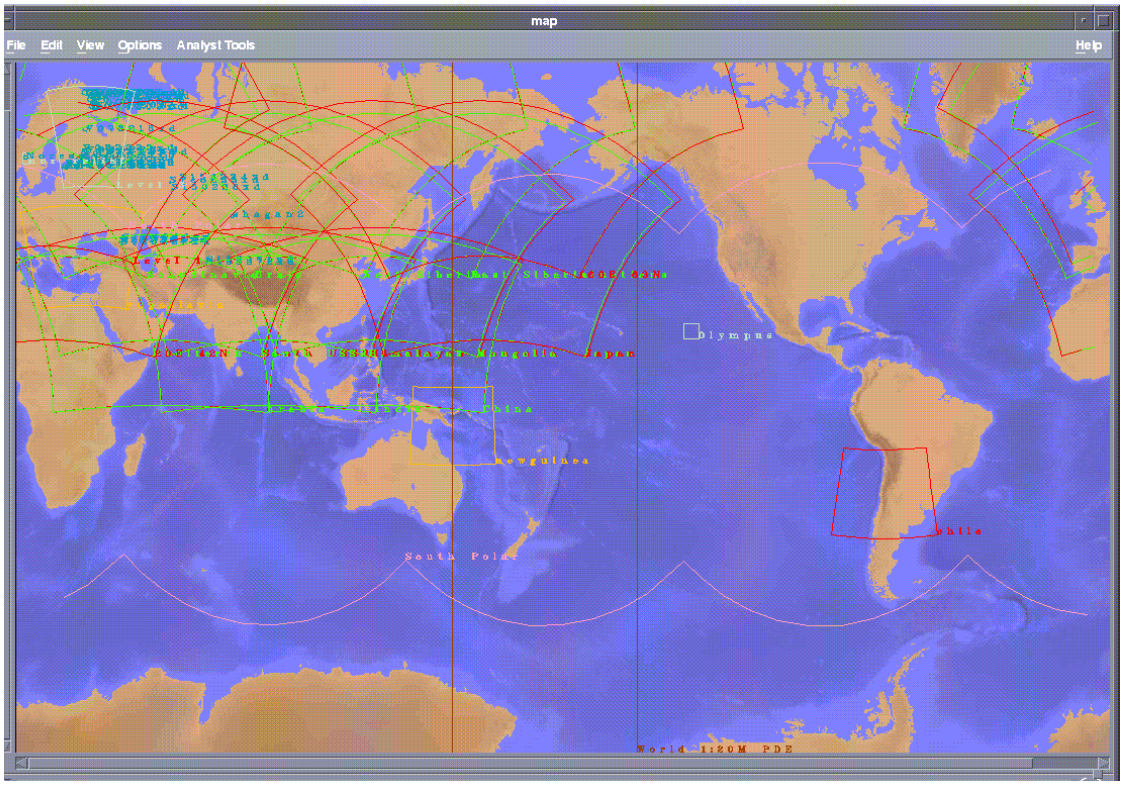


FIGURE 184. MAP OUTLINES AVAILABLE IN MAP

View > Map Outlines > Unshow Map Outlines

The Unshow Map Outlines option removes the map outlines from the current map displayed. Outlines are displayed by invoking the Map Outlines > Show Map Outlines option.

To remove the map outlines:

1. Select View > Map Outlines > Unshow Map Outlines.

   The map outlines displayed using Map Outlines > Show Map Outlines are removed from the *Map* display.

View > Map Outlines > Show Selected Map

You can display one of the map views by first selecting one of the outlines displayed by Map Outlines > Show Map Outlines, and then selecting View > Map Outlines Show Selected Map.

To display one map view from the selection of map views:

1. Click on the outline of the desired map view.
2. Choose View > Map Outlines > Show Selected Map.

   Map displays the selected map view.

View > View Maps

The View Maps submenu shown in Figure 185 provides options for displaying different map views.

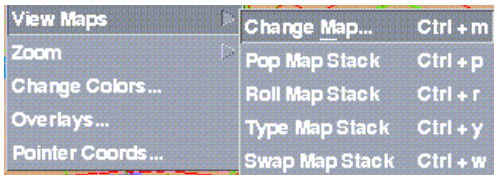


FIGURE 185. VIEW MAPS OPTIONS IN MAP

View > View Maps > Change Map...

The Change Map… option lists all available maps and allows you to select one for display.

To display a different map from that currently displayed:

1. Choose View > Change Map…

   A list of maps is displayed in a dialogue box, as shown in Figure 186.

2. Select a map, then click OK.

   The view changes to the map you selected.

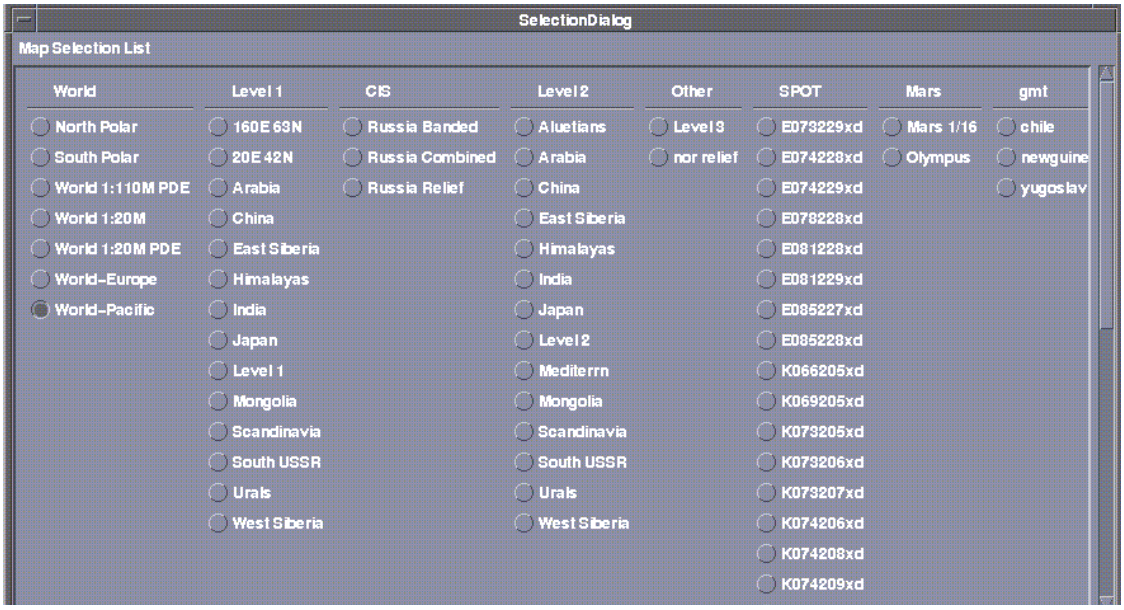


FIGURE 186. LIST OF MAP VIEWS AVAILABLE IN MAP

View > View Maps > Pop Map Stack, Roll Map Stack, Type Map Stack, Swap Map Stack

Using options in the View > View Maps > Change Map submenu you can switch to a previously displayed map. Each time you display a new map, the previous map is pushed on the "map stack" or list of previously displayed maps. Using the Pop, Roll, and Swap map stack options, you can manipulate the viewed map using views saved in the map stack. The Pop option replaces the current map with the map on the top of the stack or the last displayed map; the current map is not saved

on the stack. The Roll option "rolls the stack" or replaces the current map with the map on the top of the stack and moves the current map to the end of the stack. The Swap option exchanges the current map for the one on the top of the stack; repeated use of this option toggles the display between two maps. The Type Map Stack option lists the current map stack in the Scheme window.

View > Zoom

The Zoom option "zooms" into specific features in the currently displayed map.

To Zoom:

1. With the middle mouse button, click within the current *Map* display, and while dragging the middle mouse button draw a rectangle around the area of the map you wish to enlarge.

   Map displays an information box while the display is zooming into the selected region.

   Map enlarges the selected area to fill the Map display, as shown in Figure 187.

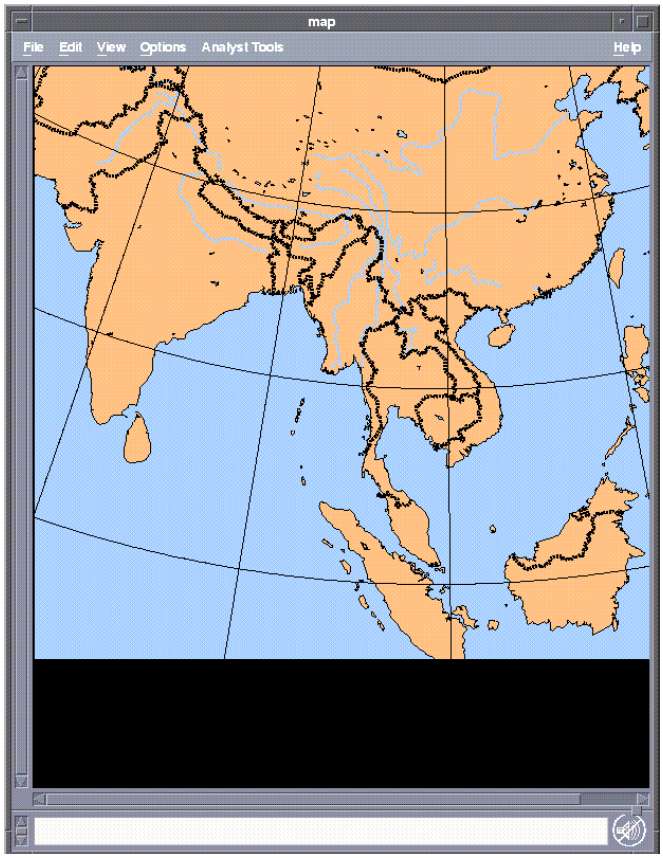


FIGURE 187.ZOOMED IMAGE

View > Change Colors...

Some maps can be displayed using different color themes. Selecting the Change Colors... option displays a list of selectable colors in addition to those already displayed.

View > Overlays...

Overlays are an important feature of *Map*. They allow you to superimpose features on the current display to provide more information than provided by the default map. Figure 188 shows the overlays that are available. They include such features as a latitude/longitude grid, high or low seismicity displays, and station locations.

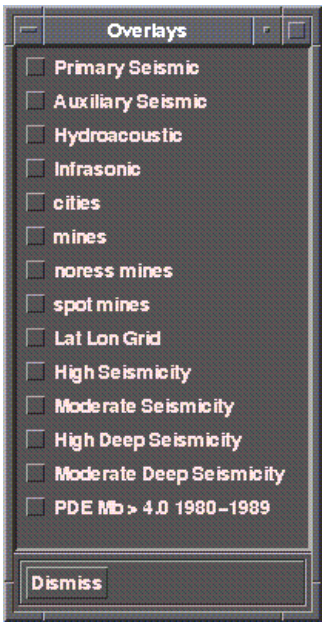


FIGURE 188. OVERLAYS AVAILABLE IN MAP

To display overlays superimposed on the current *Map* display:

1. Choose View > Overlays…

   A list of Overlays available in *Map* is displayed in a dialogue box.

2. Select one or more overlays by clicking in the boxes beside the desired item.

   As they are selected, *Map* displays the overlays in front of the current map background. When you have finished selecting overlays, click Dismiss in the dialogue box.

Figure 189 provides an example of two overlays superimposed on a global map, high seismicity areas, and latitude/longitude grids.

To remove overlays, reselect:

1. Choose View > Overlays…
2. Unselect those overlays that are no longer needed.

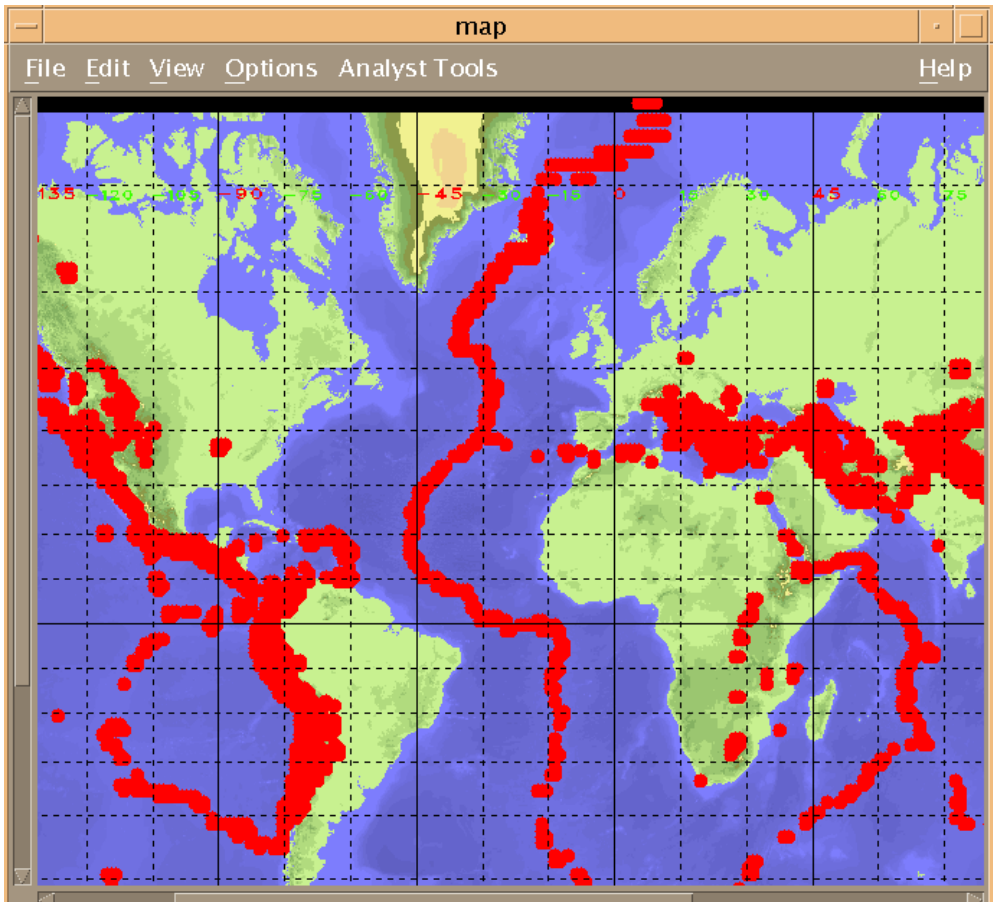


FIGURE 189. MAP DISPLAY OVERLAYS

View > Pointer Coords…

The Pointer Coords… option displays a dialogue box that provides continuous latitude and longitude data based on the mouse's position on the *Map (*Figure 190). If the right mouse button is used to select a point, the dialogue box displays additional information. Further mouse movement now causes the display of distance, azimuth, and back azimuth between the selected point and the current mouse cursor position. See the Options menu discussed next for further information on selected points.

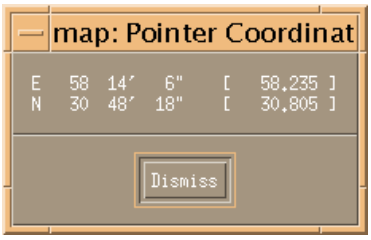


FIGURE 190.MAP MOUSE POINTER COORDINATES

To view pointer coordinates:

1. Choose View > Pointer Coords…

   A dialogue box, which continuously updates the mouse cursor position in units of latitude and longitude, is displayed.

Options Menu

The Options menu shown in Figure 191 provides options related to using selected points. Click the right mouse button to mark a point on the displayed map in red. A dynamic line connects the current mouse position to the selected point. Right click again to mark a new point and move the origin of the dynamic line. Additional options are provided that use one or two of these selected points. The options clear the points and dynamic line in addition to performing their specific function.

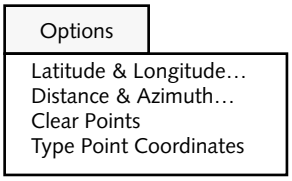


FIGURE 191. OPTIONS MENU IN MAP

Options > Latitude & Longitude, Distance & Azimuth, Type Point Coordinates, Clear Points

To use the *MAP* options:

1. Click the right mouse button on the map to place a point on the map.
2. Choose Options > Latitude & Longitude.

   A dynamic line follows the mouse as you choose the option.

   A dialogue box displays the latitude/longitude of the selected point and then clears the point.
3. Right click the mouse to select two points.
4. Choose Options > Distance & Azimuth.

   A dialogue box displays the coordinates of both points, the distance and azimuth between them, and then clears the points.

The Type Point and Clear Point options provide these static display boxes, which do not update with mouse movement. Pointer Coords…, described in the previous section, provides a continuously updating display of latitude, longitude, distance, and azimuth.

To display and Clear Points:

1. Select more points.

2. Choose Type Point Coordinates.

   The point coordinates are printed in the Scheme window, but are not cleared from the display.

3. Choose Options > Clear Points.

   All points and the line attached to the mouse are removed.

Analyst Tools Menu

The Analyst Tools menu shown in Figure 192 is used to send data from *Map* to *ARS*.

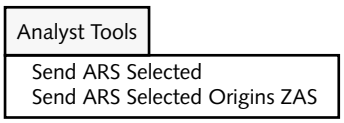


FIGURE 192. MAP ANALYST TOOLS MENU

Analyst Tools > Send ARS Selected

The Send ARS Selected option sends a message to *ARS* requesting that arrivals, origins, and origerrs selected in *Map* be added to the *ARS* selection list. That is, objects selected in *Map* will become selected in *ARS*.

To send selected *Map* objects to *ARS*:

1. Select arrivals/origins in *Map* by left clicking on the objects.

   The objects turn black when selected.

2. Choose Analyst Tools > Send ARS Selected.

   All arrivals and origins selected in *Map* become selected in *ARS*.

Analyst Tools > Send ARS Selected Origins ZAS

This option is more comprehensive than the previous. "ZAS" stands for zoom, align, and sort. *Map* sends a similar message to *ARS* containing a list of selected objects. However, when *ARS* receives the message all objects selected in *ARS* become deselected, then everything selected in *Map* becomes selected in *ARS*. The *ARS* waveform display zooms on the newly selected origin. Waveforms are aligned on P-phase and are sorted by distance to the event.

In spite of the function's name, there must be one and only one origin selected in *Map* or this function will fail.

ANOMALOUS EVENT QUALIFIER (AEQ) PROCEDURES

AEQ Window Layout and Organization

AEQ provides an indication of how statistically anomalous an analyzed event is. *AEQ* reports the probability that the event is in an unusual location, or has unusual magnitude or depth compared to previous events that have occurred in that region. The rational that *AEQ* uses to flag events is described in [GSE92].

Figure 193 shows the output of an event that has been assessed by *AEQ*. A separate *AEQ* report window is generated for each event queried. The report consists of the event's origin identifier, four event attributes rated for anomaly between zero and one, and an overall assessment value also ranging between zero and one.

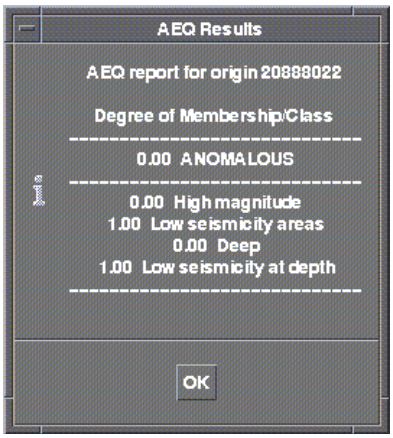


FIGURE 193. ANOMALOUS EVENT QUALIFIER (AEQ)

Figure 194 shows the summary output line of *AEQ*. A 0.00 value means that the event is not anomalous. A 1.00 value means that the event is extremely anomalous for the event location. A high value might mean that the area is tectonically inactive, and therefore, events should seldom occur there. Or it may mean that the computed depth is extremely unusual, or, from a plate tectonic standpoint, improbable for that area. If you see a high value in the summary line and are confident of your analysis, consult with a lead analyst. In general, you may wish to discuss results that are greater than 0.30, or if results are not flagged solely on the basis of a high magnitude, results greater than 0.20.

FIGURE 194. AEQ ANOMALOUS OUTPUT

The assessments of individual attributes of the event are located beneath the overall summary line. Figure 195 presents the high magnitude attribute. Only excessively high magnitudes are flagged here; low magnitudes are not flagged. A 0.00

means that nothing unusual was found concerning the magnitude of the event. As the number becomes larger, the magnitude is assessed as being more and more unusual for the area, with 1.00 being very unusual.

.

FIGURE 195.AEQ MAGNITUDE OUTPUT

Figure 196 shows the low seismicity areas output. This indicates how active the seismicity is in the calculated location region. A 0.00 indicates that the event has occurred in an active seismic area, producing many natural events, and therefore, is not unusual. The maximum value 1.00 means that the event is located in an historically very low seismic activity area. However, a 1.00 may not necessarily trigger a high value in the summary line if the low seismicity area is assessed as a reasonable location for a natural event. For example, few events may occur along a particular tectonic plate boundary, but if one does, it is assessed as being reasonable. Therefore, the summary line will still indicate that the event is not anomalous overall.

FIGURE 196.AEQ LOW SEISMICITY AREAS OUTPUT

The Deep attribute output is displayed below the low seismicity areas, as shown in Figure 197. This output indicates that the event is deep. An output of 0.00 Deep means that the event was calculated to have occurred at the surface, while 1.00 Deep means that the event was deep.

FIGURE 197.AEQ DEEP OUTPUT

The last line in the *AEQ* output displays the low seismicity at depth, as shown in Figure 198. This value indicates that the calculated depth is anomalous for the region. If the calculated event's depth is reasonable and common for the area, the depth output displays 0.00 low seismicity at depth. If the depth is unreasonable for the calculated hypocentral location, the output displays 1.00 low seismicity at depth. As with the low seismicity areas, it is possible for the depth to be historically uncommon, which means that 1.00 low seismicity at depth is displayed, but is still considered acceptable for the tectonic region. In this case, the summary output at the top of the *AEQ* display may still indicate that the event is not anomalous (0.00 ANOMALOUS).

FIGURE 198.AEQ LOW SEISMICITY AT DEPTH OUTPUT

AEQ Procedures Summary

During regular analysis *AEQ* is generally consulted as one of the final steps in analyzing an event. After refining the location as much as possible, and with the event selected, analysts select Tools > AEQ. This will send a message to *AEQ* to assess the event. *AEQ* is launched if it is not already running. When *AEQ* has finished assessing the event it reports the degree of anomalousness in an *AEQ* report window. When you have finished reviewing the results, you can close the output display by clicking OK. However, you can keep display windows open. *AEQ* launches another display window for each new message sent from *ARS*.

AEQ Menus

AEQ contains one pull-down menu, the File menu. To exit the *AEQ* program, choose File > Exit. No other menus or options are available in *AEQ*.

INTERACTIVE AUXILIARY DATA REQUEST (IADR) PROCEDURES

IADR allows you to request additional auxiliary waveform data to supplement data already loaded into *ARS* for a particular event. Auxiliary station data are different from continuous or so-called primary station data in that they do not arrive at the IDC on a continuous basis. Instead, auxiliary data are requested from the recording station through the Message Subsystem (see [IDC3.4.1Rev2] and [IDC7.4.2]), when needed to improve event location. The automatic system generally estimates what auxiliary data are required and makes requests accordingly.

In the course of analyzing an event the data from certain auxiliary stations, which were not requested during automatic processing, might contribute to event refinement. Also, events built during scanning will not have had auxiliary data requested by the automatic system. The ability to request additional auxiliary data during an analysis session is made available through *IADR*.

Requesting Data and WEAssess

The *WaveExpert* application is used by the automatic system to make auxiliary data requests. *IADR* uses two instances of *WaveExpert,* to assist in requesting auxiliary data interactively: *WEAssess* and *WERequest*. *WEAssess* is launched automatically at the beginning of an analysis session because it takes longer than most tools to initialize. Usually by the time you wish to make a request, *WEAssess* is ready and listening for messages. Its client window appears iconified on the screen opposite *ARS*.

You initiate requests for auxiliary data from the Tools menu in *ARS,* as shown in Figure 199.

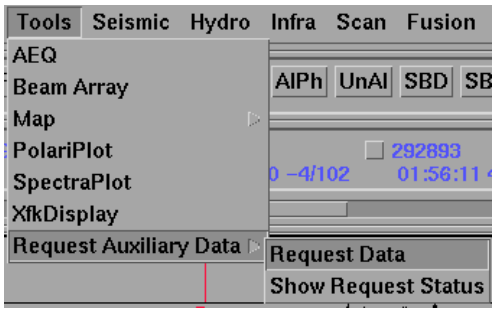


FIGURE 199. GENERATING DATA REQUEST FROM ARS

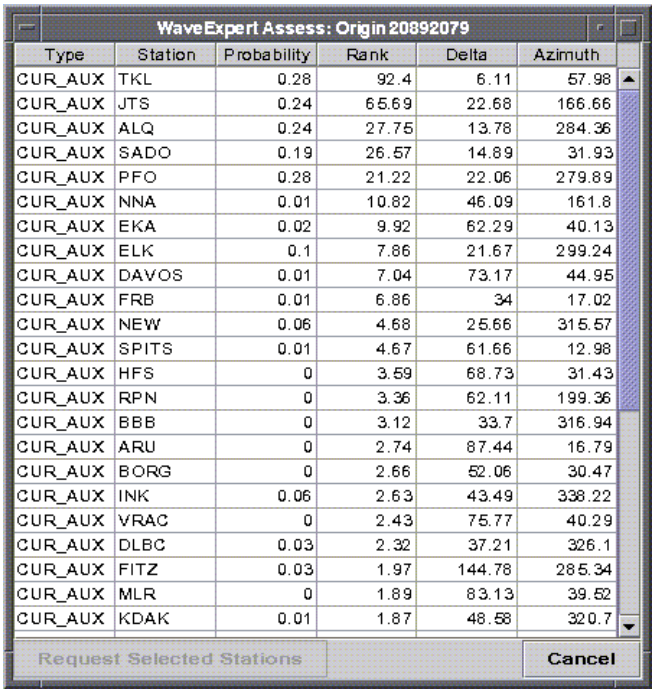
To request auxiliary data:

1. In the *ARS* choose Tools > Request Auxiliary Data > Request Data (see "Tools > Request Auxiliary Data" on page 143).

   The *WEAssess* tool with a list of stations appears, as shown in Figure 200.

The *WEAssess* tool contains a list of all auxiliary stations that are available for data request during normal operations. In Figure 200 the list is from the CUR_AUX network. Table 16 describes the six columns in *WEAssess*.

By default, stations are displayed in order of highest to lowest rank. To change the sorting order, click once using any mouse button on the column header whose values determine the station sort order. For example, to sort stations based on distance to the event, click once on the header marked Delta. The stations are sorted by distance to the event, with the closest station at the top. If you click the same header again, the stations sort in reverse order, with the furthest station at the top. This result is illustrated in Figure 201. The arrow pointing up means stations are sorted from lowest delta (closest station) at the top to highest delta (furthest station) at the bottom. Pointing down means stations are sorted from highest to lowest.



Type	Station	Probability	Rank	Delta	Azimuth
CUR_AUX	TKL	0.28	92.4	6.11	57.98
CUR_AUX	JTS	0.24	65.69	22.68	166.66
CUR_AUX	ALQ	0.24	27.75	13.78	284.36
CUR_AUX	SADO	0.19	26.57	14.89	31.93
CUR_AUX	PFO	0.28	21.22	22.06	279.89
CUR_AUX	NNA	0.01	10.82	46.09	161.8
CUR_AUX	EKA	0.02	9.92	62.29	40.13
CUR_AUX	ELK	0.1	7.86	21.67	299.24
CUR_AUX	DAVOS	0.01	7.04	73.17	44.95
CUR_AUX	FRB	0.01	6.86	34	17.02
CUR_AUX	NEW	0.06	4.68	25.66	315.57
CUR_AUX	SPITS	0.01	4.67	61.66	12.98
CUR_AUX	HFS	0	3.59	68.73	31.43
CUR_AUX	RPN	0	3.36	62.11	199.36
CUR_AUX	BBB	0	3.12	33.7	316.94
CUR_AUX	ARU	0	2.74	87.44	16.79
CUR_AUX	BORG	0	2.66	52.06	30.47
CUR_AUX	INK	0.06	2.63	43.49	338.22
CUR_AUX	VRAC	0	2.43	75.77	40.29
CUR_AUX	DLBC	0.03	2.32	37.21	326.1
CUR_AUX	FITZ	0.03	1.97	144.78	285.34
CUR_AUX	MLR	0	1.89	83.13	39.52
CUR_AUX	KDAK	0.01	1.87	48.58	320.7

FIGURE 200. WAVEEXPERT ASSESS (WEASSESS) TOOL – LIST OF STATIONS

TABLE 16: WEASSESS COLUMN DESCRIPTIONS

Header	Description
Type	Type of station (network affiliation, for example, the CUR_AUX network).
Station Name	Station name.
Probability	Probability of detection based on a combination of station background noise, attenuation curves, and distance.

TABLE 16: WEASSESS COLUMN DESCRIPTIONS (CONTINUED)

Header	Description
Rank	Weighted value based on the predicted reduction in the error ellipse of the current location's error ellipse if this stations data were added to the location computation. A high number means that significant reduction in the error ellipse is predicted with use of this station.
Delta	Distance from the event in degrees.
Azimuth	Station-to-event azimuth.

A. Stations sorted lowest to highest

Delta ▲
6.11
13.78
14.89
21.67
22.06
22.68
25.66
33.7
34
37.21
43.49
46.09
48.58
52.06
61.66
62.11
62.29
68.5
68.73
73.17
75.77
81.47
83.13

B. Stations sorted highest to lowest

Delta ▼
144.78
137.56
128.48
123.92
122.75
112.3
110.52
104.08
102.55
99.47
99.13
97
92.53
89.8
87.44
83.13
81.47
75.77
73.17
68.73
68.5
62.29
62.11

FIGURE 201.WEASSESS COLUMN SORTING OPTIONS

The sorting changes as follows for each selected header:

- Type – Stations are sorted by type in alphabetical order. (CUR_AUX is the only type currently used.)
- Station – Stations are sorted alphabetically.
- Probability – Stations are sorted by probability of detection.
- Rank – Stations are sorted by rank.
- Delta – Stations are sorted by distance to the event.
- Azimuth – Stations are sorted by station-to-event azimuth.

When the *WEAssess* tool appears it may have stations pre-selected. Selected stations appear highlighted in purple. This automatic preselection is based both on rank and probability. Preselection is a convenience. If you are satisfied with the select list displayed automatically, you need not select other stations.

You can add or remove stations from the select list by using the following techniques:

- To select a station, click to select the desired station. This unselects all other stations.
- To select a continuous block of stations, select the first station in the desired block, and drag the mouse to the last station in the block. Or select the first station and press shift key and select the last station. Figure 202 shows a continuous block of selected stations.

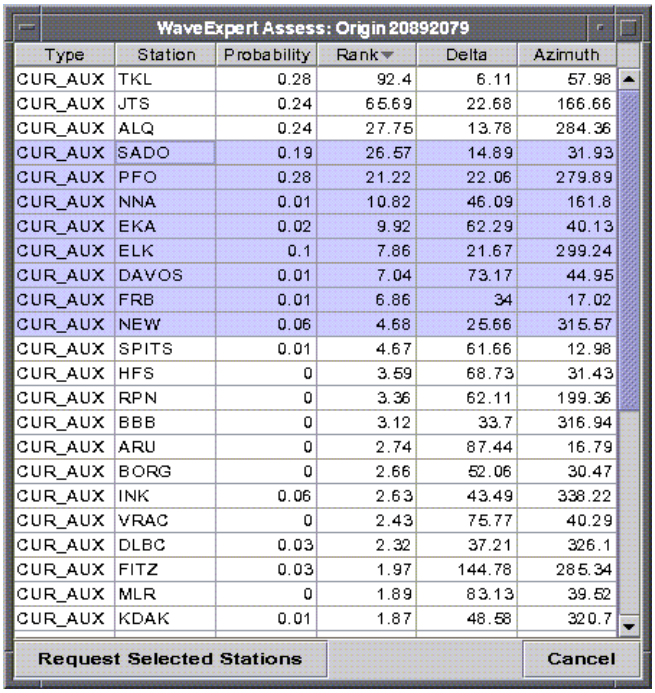
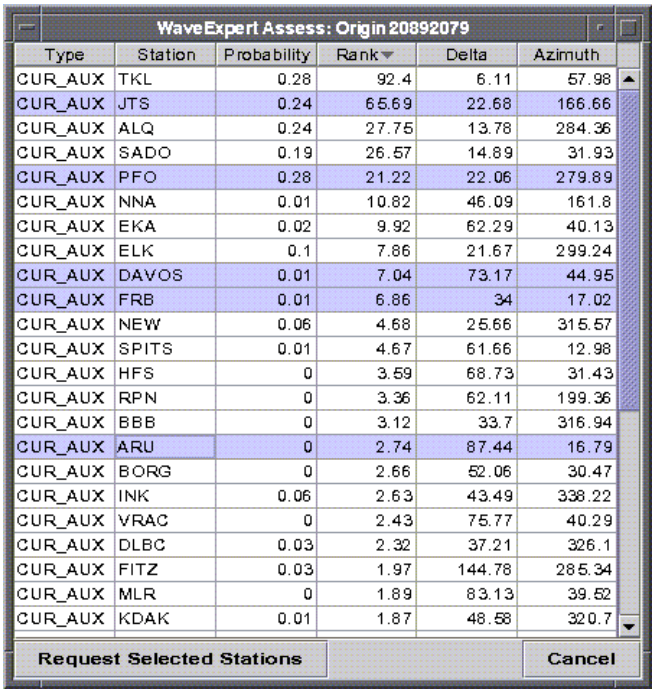


FIGURE 202. BLOCK OF SELECTED STATIONS

- To select additional stations that are not listed contiguously, such as the example in Figure 203, press the Control key while selecting stations one at a time. Using the Control key, you can skip over stations in the sorting order while making selections.



Type	Station	Probability	Rank	Delta	Azimuth
CUR_AUX	TKL	0.28	92.4	6.11	57.98
CUR_AUX	JTS	0.24	65.69	22.68	166.66
CUR_AUX	ALQ	0.24	27.75	13.78	284.36
CUR_AUX	SADO	0.19	26.57	14.89	31.93
CUR_AUX	PFO	0.28	21.22	22.06	279.89
CUR_AUX	NNA	0.01	10.82	46.09	161.8
CUR_AUX	EKA	0.02	9.92	62.29	40.13
CUR_AUX	ELK	0.1	7.86	21.67	299.24
CUR_AUX	DAVOS	0.01	7.04	73.17	44.95
CUR_AUX	FRB	0.01	6.86	34	17.02
CUR_AUX	NEW	0.06	4.68	25.66	315.57
CUR_AUX	SPITS	0.01	4.67	61.66	12.98
CUR_AUX	HFS	0	3.59	68.73	31.43
CUR_AUX	RPN	0	3.36	62.11	199.36
CUR_AUX	BBB	0	3.12	33.7	316.94
CUR_AUX	ARU	0	2.74	87.44	16.79
CUR_AUX	BORG	0	2.66	52.06	30.47
CUR_AUX	INK	0.06	2.63	43.49	338.22
CUR_AUX	VRAC	0	2.43	75.77	40.29
CUR_AUX	DLBC	0.03	2.32	37.21	326.1
CUR_AUX	FITZ	0.03	1.97	144.78	285.34
CUR_AUX	MLR	0	1.89	83.13	39.52
CUR_AUX	KDAK	0.01	1.87	48.58	320.7

FIGURE 203. NON-CONTINUOUS SELECTION OF STATIONS

Map Selected Stations

WEAssess contains one pop-up option, which calls the *Map* function. When displayed *Map* plots two sets of stations. It displays the stations and travel paths of stations that are already loaded into *ARS* and whose waveforms contain phases that are being used to locate the event. These are displayed in black. *Map* also displays stations that you have highlighted in *WEAssess* for request. These are displayed in red. This feature allows you to see the distribution of existing and requested stations around the event and evaluate which stations would contribute most to an event location.

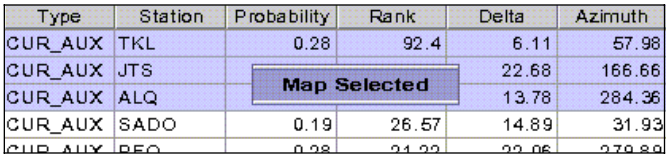


FIGURE 204. MAP SELECTED OPTION IN WEASSESS

To see the distribution of stations in *Map*:

1. Click on one of the highlighted stations in *WEAssess* with the right mouse button. A pop-up menu called Map Selected appears, as shown in Figure 204. Move the cursor onto this menu option and select it.

   Map is launched and displays two sets of stations, as shown in Figure 205. The stations displayed in black represent stations already loaded into *ARS* that contain associated arrivals. The stations displayed in red represent stations highlighted in *WEAssess*, which is ready to be requested. The travel paths between event and station are also displayed. Additional selections in *WEAssess* must be present to show up in *Map*.

FIGURE 205. MAP LAUNCHED FROM WEASSESS

Select Requested Stations

The Select Requested Stations button initiates a request from the selected stations. Based on the event's current location, a waveform time segment surrounding a theoretical P arrival time is requested.

To initiate the request for auxiliary data:

1. After selecting the desired stations, click Select Requested Stations.

   A request is made via the Message Subsystem for data from the highlighted stations. The *WEAssess* window disappears. An iconified window called *WERequest* appears. This window displays error messages related to the request. You need not monitor this window.

Cancel

The Cancel exits the *WEAssess* program (without requesting data from any highlighted stations).

Viewing Request Status and IADR

The *IADR* status tool provides an interface where the amount of data that has been returned for auxiliary data requests can be monitored. When requested data are received they can be transferred to *ARS* for display via the *IADR* status tool. The status tool is launched from *ARS*.

To view the status of ongoing requests:

1. In *ARS* choose Tools > Request Auxiliary Data > Show Request Status (see "Tools > Request Auxiliary Data > Show Request Status" on page 144.)

   The *IADR* status tool, consisting of a GUI and an iconified client window, launches.

The *IADR* status tool displays a list of all auxiliary data requests made for the time period allocated in *ARS,* as shown in Figure 206. This includes requests made by the automatic processing system for the SEL1 and SEL2 pipeline as well as interactive requests at the top of the *IADR* status tool display. A folder symbol with the requestor's name is shown. The name shown is the requestor's login user name. This folder contains all requests made by that requestor. Each requestor has their own folder. `sel1` and `sel2` are listed as separate requestors and show which auxiliary stations' data have already been requested for the allocated time period.

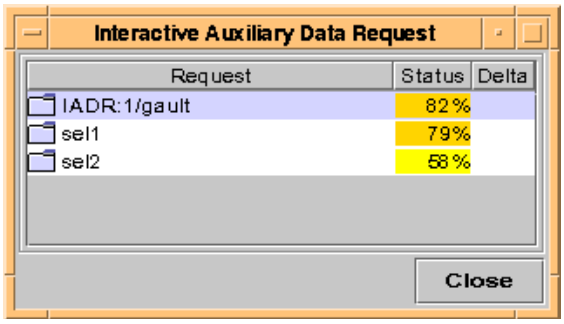


FIGURE 206. USER NAME LEVEL IN IADR STATUS WINDOW

Table 17 describes the columns of the *IADR* status tool.

TABLE 17: IADR COLUMNS

Column Header	Description
Request	Folders listing the data requests. Folders contain sub-folders and may be expanded to detail return status by evid, station, or channel.
Status	Displays the status of a request. The percentage of data returned is displayed. The cell color indicates status as follows: ■ red — less than 50 percent data returned ■ yellow — between 50 percent and 70 percent data returned ■ orange — between 70 percent and 90 percent data returned ■ green — between 90 percent and 100 percent data returned
Delta	Station to event distance in degrees (only when stations are shown).

The *IADR* status tool interface is presented as an expandable tree structure of folders starting with the user level as shown in Figure 206. Clicking on folders with the left mouse button displays subfolders in the order of evids, stations, and finally channels. Figure 207 shows a variety of folder levels open and closed.

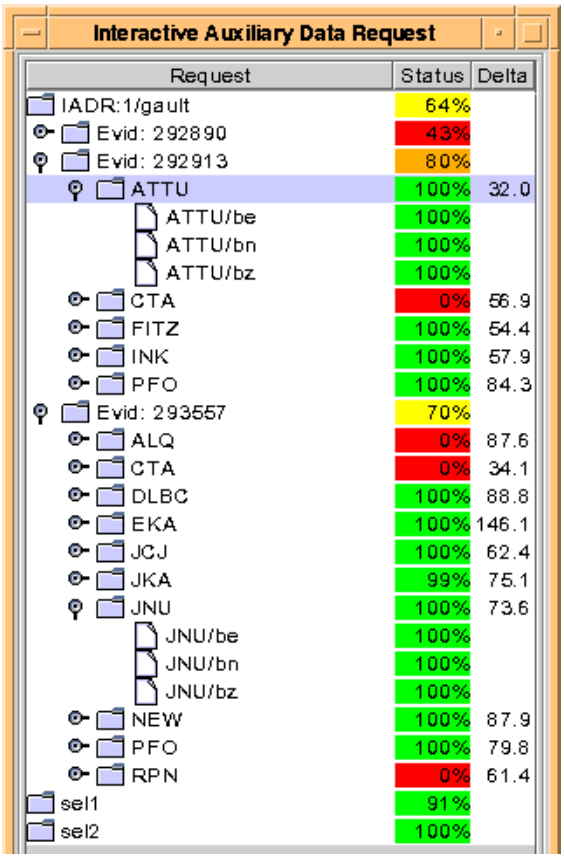


FIGURE 207.IADR (FOLDER LEVELS IN IADR STATUS WINDOW)

To view individual *IADR* status levels:

1. Click the left mouse button once on a folder symbol in the *IADR* status tool.

   The folder expands or unexpands depending on its current status.

2. Click Close at the bottom of the screen.

   The *IADR* status window is dismissed.

Status Window Pop-up Menu

In the *IADR* status tool, two pop-up menu options are available for each channel-level folder, as shown in Figure 208. The Show Selected option transfers data for the highlighted station into *ARS* for display. The Map Selected option displays the highlighted station on the *Map* display.

FIGURE 208.IADR POP-UP OPTIONS

To *Map* station locations:

1. Select the stations using the left mouse button.
2. To display the pop-up menu, click once with the right mouse button anywhere in the highlighted area.
3. Choose Map Selected.

   Map displays the highlighted stations.

To display received auxiliary data in *ARS*:

1. Select the applicable stations using the left mouse button.
2. To display the pop-up menus, click once with the right mouse button anywhere in the highlighted area.
3. Select Show Selected.

   The waveform data for the selected stations is transferred to *ARS*. The received channels are displayed, sorted by distance from the event and aligned on the default phase.

HYDROACOUSTIC AZIMUTH REVIEW TOOL (HART) PROCEDURES

HART is an interactive hydroacoustic tool designed to aid in determining the direction a hydroacoustic signal is arriving from. *HART* works with data from hydroacoustic station groups and analyzes the passage of a signal through the group. A hydroacoustic station group consists of several hydrophone stations within a localized geographic region. By convention their station names all start with the same prefix. (For example, all the Ascension Island stations belong to one hydroacoustic group, namely the Ascension group.) Even though each hydrophone is processed as a separate station, together they are treated as a collective unit for azimuthal processing in *HART*.

The *HART* tool is the interactive complement to the automatic *Hydroacoustic Azimuth Estimator* (*HAE*) processing. *HAE* makes an estimate of the azimuth of an arrival during automatic processing prior to analyst review. Like *HART*, *HAE* uses the concept of a Hydro Arrival Group (HAG). A HAG is a set of arrivals occurring at stations in a hydroacoustic station group that are evaluated as originating from the same source. The formation of a HAG by the automatic processing system follows specific rules:

- A hydroacoustic arrival group is made up of two or more arrivals.
- All arrivals in a HAG must belong to stations within the same station group.
- A HAG cannot have more than one arrival per station.
- At most one arrival in a HAG can be event defining.

Because the hydrophones (stations) within a station group in the International Monitoring System (IMS) can be placed at large distances from each other, possibly beyond the coherence length of many hydroacoustic signals, the *HART* tool provides methods other than coherent waveform processing. By default, *HART* correlates the waveform envelopes recorded at each station within a group and, based on highest correlation of these waveforms, estimates a station-to-event azimuth.

HART Window Layout and Organization

Figure 209 shows the *HART* tool display. The left side of the display shows the waveform envelopes belonging to the stations in the station group, aligned on their points of maximum correlation. The right side of the display shows the F-statistic annulus. The F-statistic indicates the degree of correlation or similarity between the waveform segments. Highest correlation within the waveform is represented in red. Lowest correlation is represented in blue. Three pointer bars, radiating out from the center of the annulus, represent station-to-event azimuth based on the current location of the event in *ARS* (purple), the automatic processing estimate of signal azimuth (blue), and the analyst-reviewed estimate of azimuth (yellow). Parameter information, such as azimuth and slowness, from both the automatic processing and your review are displayed textually below the annulus.

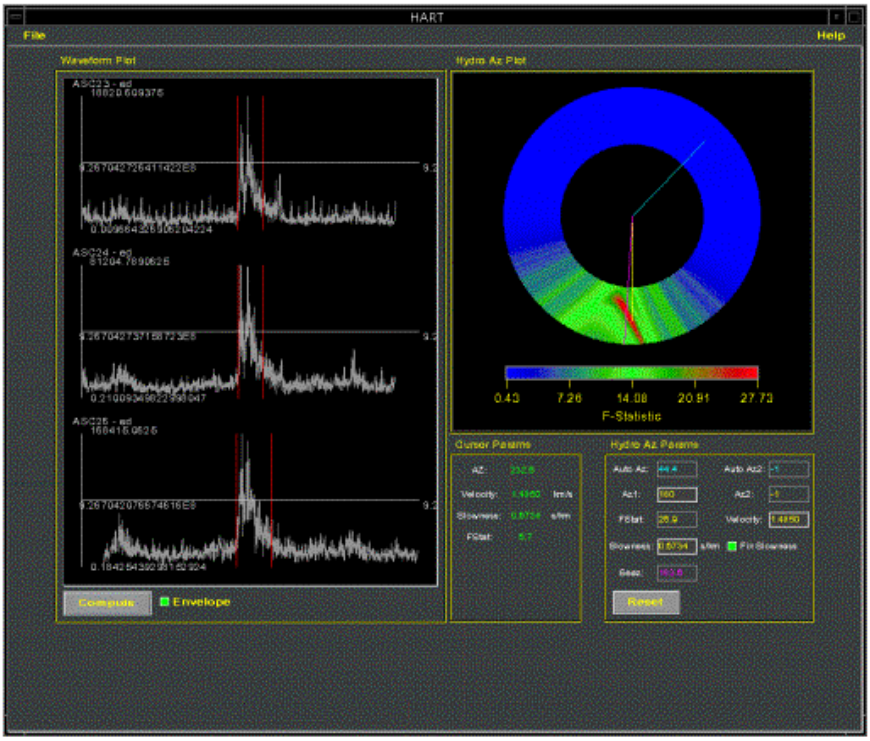


FIGURE 209.HART

Figure 210 shows a close-up of the F-statistic annulus. The slowness plane appears as a donut shape instead of a continuous plane as is used in *XfkDisplay*, because it only covers phase velocities from 1.47 km/s to 1.59 km/s. The length of the pointer bars represent slowness, their ends pointing to the slowness value calculated for the displayed signal. The colors within the annulus represent the F-statistic [IDC5.2.1] for correlation between the waveform segments. The higher the correlation between waveforms, the greater the confidence that the signal energy in the waveforms of the station group originates from the same signal source and can be used to accurately determine the azimuth of the signal. The color scale representing F-statistic is displayed in the color bar below the annulus.

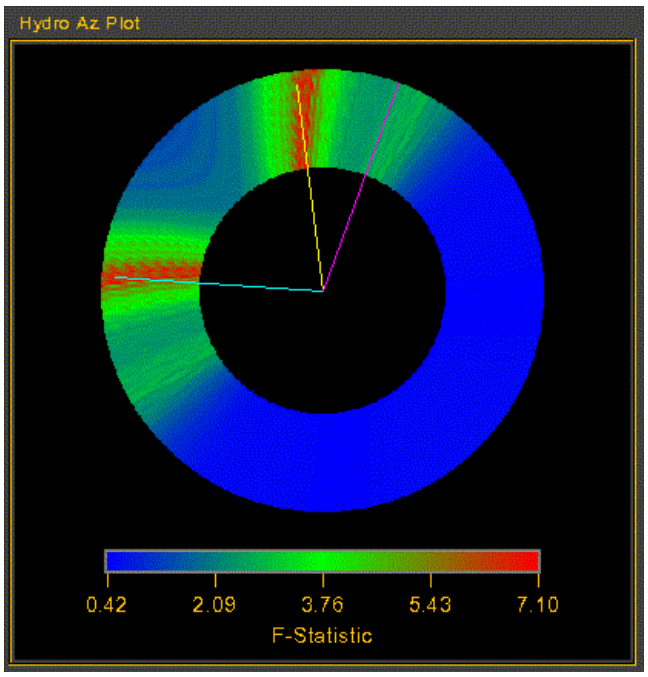


FIGURE 210.HART F-STATISTIC ANNULUS

The color coding for the three azimuth bars present in the HART annulus is as follows:

- Blue

  Azimuth calculated by *HAE* for the HAG during automatic processing. You cannot modify this bar. In the two station case, where an azimuth cannot be uniquely determined, *HART* chooses between the two equivalent solutions based on the azimuth to the location of the event selected in *ARS*.

- Purple

  Station-to-event azimuth. You cannot modify this bar. The purple azimuth points to the event selected in *ARS*. The better the event's location solution in *ARS*, the more this azimuth can be relied on as a guide.

- Yellow

  Analyst-selected azimuth. Clicking directly within the annulus selects the position of the yellow radial bar. The yellow bar initially points to the point of maximum correlation.

Figure 211 shows the hydroacoustic parameters display, located below the annulus. The parameters display provides a quantitative representation of what appears in the annulus. The color scheme is similar to the azimuth bars in the annulus:

- Blue – values calculated by automatic processing (not modifiable).
- Yellow – values selected in *HART.*
- Purple – values related to the selected event in *ARS.*
- Green (Cursor Params box) – values calculated while slowness is fixed.

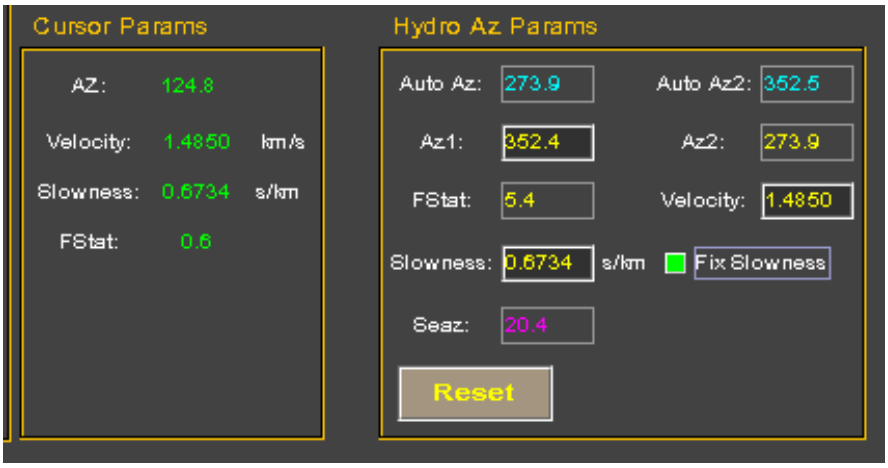


FIGURE 211. HYDROACOUSTIC PARAMETERS DISPLAY

Table 18 describes the parameters in the Hydro Params box.

TABLE 18: HYDRO PARAMS FEATURE

Box	Parameter	Description
Cursor Params	Az	Azimuth of the cursor as it moves around the annulus (deg.).
	Velocity	Velocity of the cursor as it moves around the annulus (normally fixed, unchanging at 1.485 km/s).
	Slowness	Slowness of the cursor as it moves around the annulus (normally fixed, unchanging s/km).
	FStat	F-statistic of the section of the annulus to which the cursor is pointed.

TABLE 18: HYDRO PARAMS FEATURE (CONTINUED)

Box	Parameter	Description
Hydro Az Params	Auto Az	Azimuth calculated by the automatic processing (deg.).
	Auto Az2	Second azimuth calculated by the automatic processing, for a two-station case (deg.).
	Az1	Analyst-selected azimuth; based on yellow bar in the annulus (deg.).
	Az2	For two-station case: the derived second possible azimuth, based on the first selected azimuth (deg.).
	FStat	F-statistic of analyst-selected azimuth.
	Velocity	Velocity, inverse of slowness (normally fixed at 1.485 km/s).
	Slowness (s/km)	Slowness corresponding to the length of analyst-selected, yellow azimuth bar (normally fixed, dependent on Fix button).
	Fix Slowness	When selected, slowness remains fixed. The length of the yellow azimuth bar does not change when you reposition it. When deselected, slowness is recalculated each time you select a new azimuth, depending on the length of the yellow azimuth bar.
	Seaz	Station-to-event azimuth, based on a selected event in *ARS* (deg.).
	reset	Resets the azimuth and slowness back to the last time Compute was selected (see "File > Compute" on page 282 in the HART waveform section).

Figure 212 shows the left display in the *HART* tool. The left display presents the waveform envelopes from the stations belonging to a hydroacoustic arrival group. The onset/termination bars of the signal are displayed (see "Hydro > DFX-Hydro Features" on page 155). Amplitude is measured vertically, and epoch time is displayed along the horizontal axis.

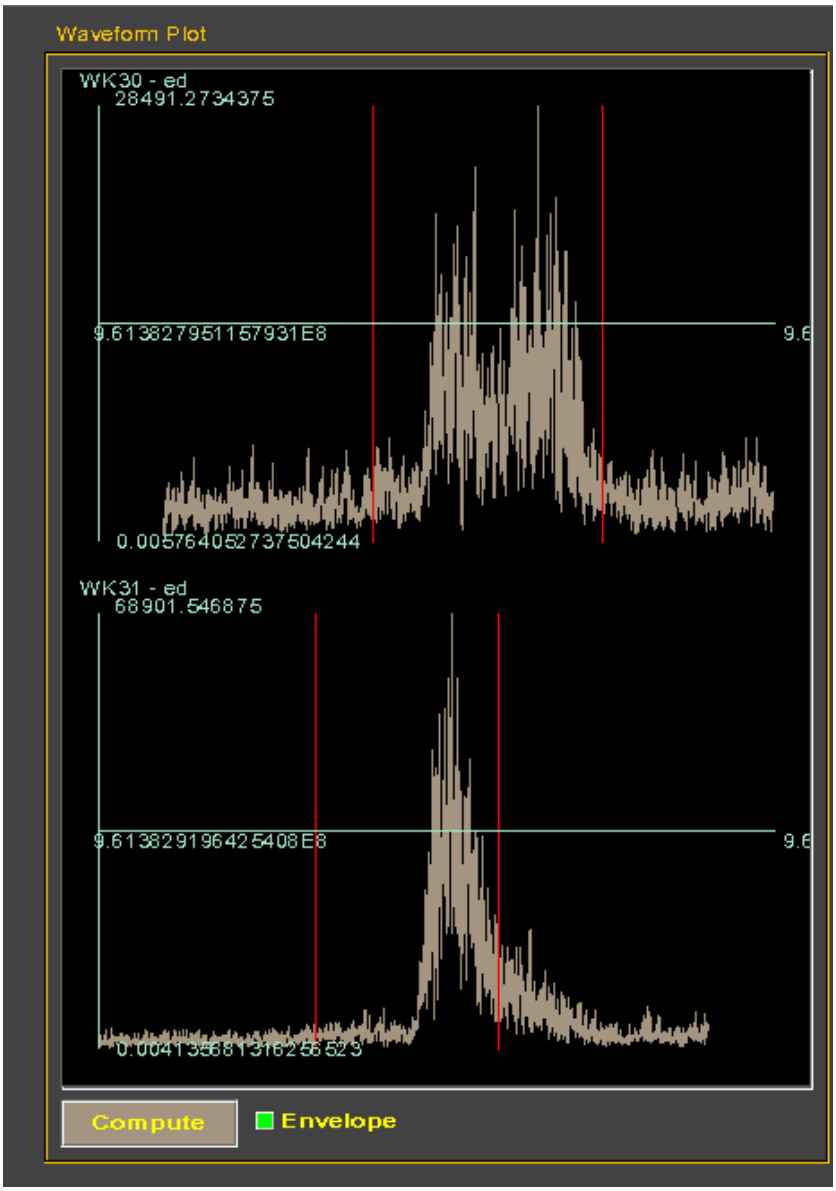


FIGURE 212.HART WAVEFORM DISPLAY

The *HART* waveform display contains several interactive features:

- Compute

  The Compute button recomputes the azimuth for the displayed data. Normally, you should recompute the azimuth when the data that *HART* has to work with changes. This includes deselecting or reselecting waveforms in *HART*.

- Envelope

  The envelope function toggles between two states. By default, you should keep the envelope function selected for IMS station data analysis, as this instructs *HART* to use only the waveform envelope in its comparison between waveform segments. If the stations are closer in distance, the full waveform data can produce better results. However, at large separations it is likely that good coherence in the signals between stations will only be found at the level of the waveform envelope, especially for earthquake-generated T phases.

  The waveforms in *HART* are displayed initially aligned on maximum correlation of the waveform segments. If you disagree with this alignment, and therefore disagree with *HARTs* display of azimuth, you can select a new azimuth within the F-statistic annulus. You will notice that the waveforms shift relative to each other to represent the offset of the waveforms caused by the azimuth adjustment.

- Deselecting Waveforms

  If you feel that one of the waveforms contributing to the azimuth calculation is displaying bad data, data drop-outs, or noise, you can disable one or more channels from azimuth processing.

At least two stations must be active for *HART* to process an azimuth.

- *HART* will return an error if less than two stations are active in the *HART* display.

To disable a channel from the *HART* azimuth calculation:

1. Click directly on the waveform segment with the left mouse button. To include a disabled channel in an azimuth computation, click directly on the disabled waveform segment with the left mouse button to make it active again.

   The background and foreground colors toggle, indicating selected and deselected states.

2. To recompute the new azimuth using only the remaining waveforms, select Compute.

   A new azimuth is be calculated.

Figure 213 and Table 19 describe the plot parameter fields in the *HART* tool.

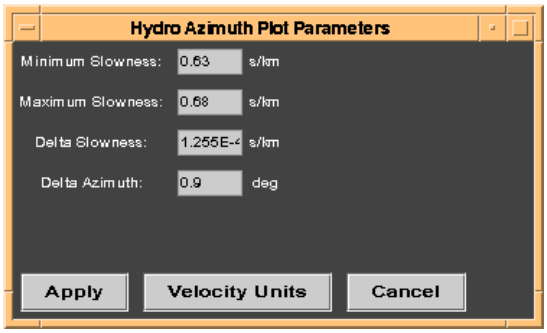


FIGURE 213. HYDROACOUSTIC AZIMUTH PLOT PARAMETERS

TABLE 19: PLOT PARAMETERS

Box	Parameter	Description
Hydro Azimuth Plot Parameters	Minimum Slowness	Minimum slowness (set in `HART.par` file).
	Maximum Slowness	Maximum slowness (set in `HART.par` file).
	Delta Slowness	Slowness resolution (set in `HART.par` file).
	Delta Azimuth	Azimuth resolution (set in `HART.par` file).
	Apply	Sets the parameters in the *HART* tool.
	Velocity Units	Displays the above parameters in velocity units.
	Cancel	Hides the parameter window.

Figure 214 and Table 20 describe the color bar parameter fields in the *HART* tool.

FIGURE 214. COLOR BAR PARAMETERS

TABLE 20: COLOR PARAMETERS

Box	Parameter	Explanation
Color Bar Parameters	Minimum	Minimum f-statistic values currently displayed in the *HART* annulus (modifiable).
	Maximum	Maximum f-statistic values currently displayed in the *HART* annulus (modifiable).
	Outliers Transparent	Removes outlier values from the annulus display; these values turn transparent in the annulus ring.
	Apply	Applies the values set in the color plot.
	Cancel	Hides the parameter window.

Making Azimuth Adjustments

To produce the waveform alignment change shown in Figure 215, the azimuth has been modified by clicking directly within the annulus. The annulus represents the slowness plane, and clicking directly on it records a selected azimuth from the x-y axis origin (slowness or distance from the axis origin is often fixed). The yellow azimuth bar points to the selected azimuth in a blue area of low signal correlation. The waveforms have shifted out of alignment relative to each other as compared to the alignment shown in Figure 212. The general goal in adjusting azimuth is to enhance alignment of the waveforms by selecting azimuths pointing to red areas of high signal correlation in the annulus. The selected azimuth is recorded in the Hydro Az Params box and can be transferred to *ARS*.

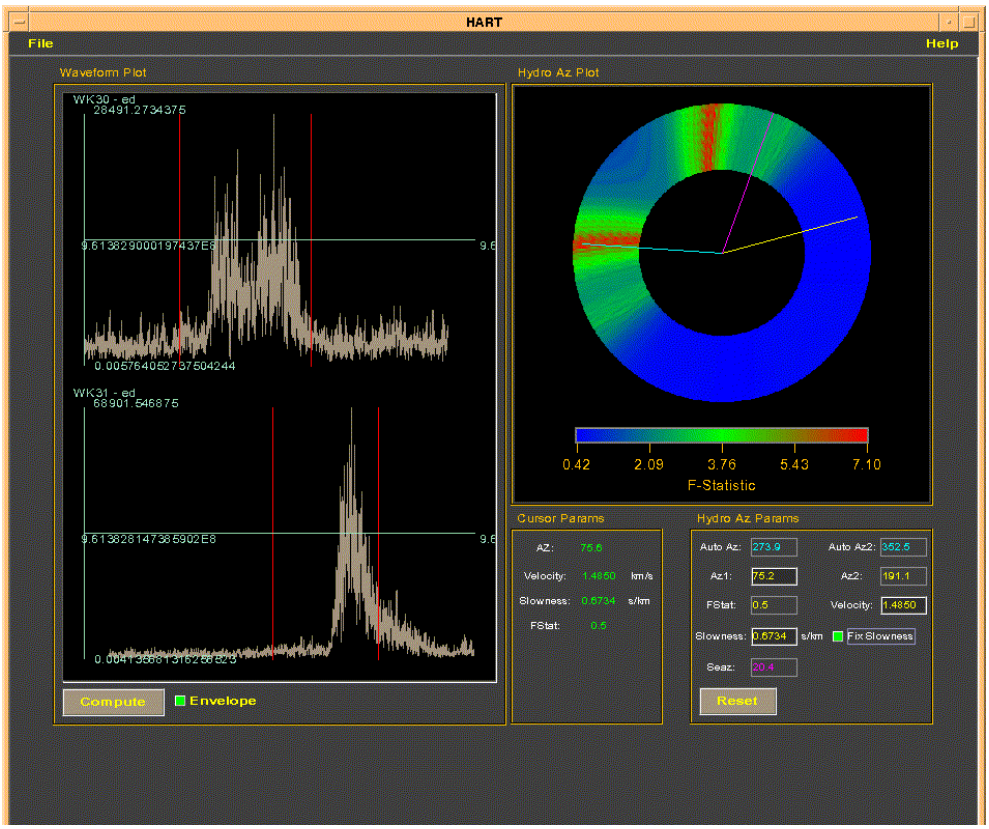


FIGURE 215. AZIMUTH MODIFICATIONS BY ANALYST

Sending Data to ARS

To send reviewed data to *ARS* from *HART*, choose Send ARS, under the *HART* File menu, as shown in Figure 216. The azimuth currently displayed in the Hydro Params box will be assigned to the arrivals in *ARS*. *ARS* updates its internal copies of the **arrival** and **hydro_arr_group** tables. When the associated arrivals are saved with the event the new information will be recorded in the database.

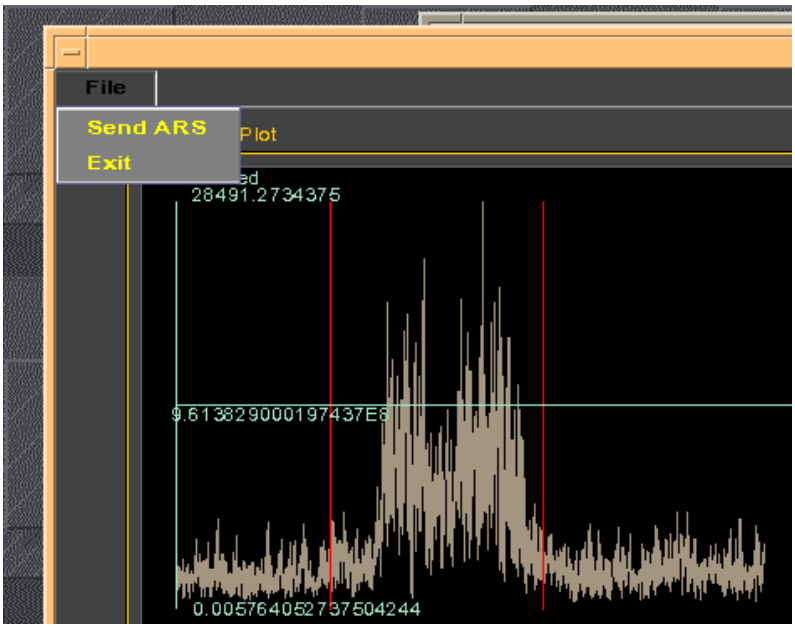


FIGURE 216.HART FILE MENU

In a two-station case where two azimuths are computed, one azimuth is assigned to the azimuth field for one of the station's arrivals, and the second azimuth is assigned to the second station's arrival. If this is a defining phase for location computation in *ARS*, only one arrival in the hydroacoustic arrival group should have any fields defining. In the two station case, this is the arrival with the preferred azimuth. When there is only one azimuth (that is, all arrivals in the hydroacoustic arrival group have the same azimuth), make the arrival with the highest snr defining.

The hydroacoustic arrival group functionality was added to *ARS* to facilitate the use of *HART*. Several *ARS* limitations are related to using hydroacoustic arrival groups. New hydroacoustic arrival groups cannot be created in *ARS*, arrivals cannot be added to an existing hydroacoustic arrival group, and all arrivals in a hydroacoustic arrival group must be associated with or disassociated from an event as a group. If

one arrival belongs to the event and another does not, the hydroacoustic arrival group is invalid and should be broken up by deleting (in *ARS*) the arrival not belonging to the event.

POLARIPLOT PROCEDURES

PolariPlot is an interactive tool that displays polarization characteristics for 3-C seismic stations whose channels are oriented orthogonally in north, east, and vertical directions. Use of *PolariPlot* has largely been replaced by the similar 3-C analysis provided by *XfkDisplay*, but *PolariPlot* provides a more detailed and controllable interface for polarization analysis, as described in [IDC5.2.1]. By default, *PolariPlot* performs an eigenvector analysis, which rotates the coordinate axes to minimize the covariance between axes. In effect this isolates and maximizes input energy onto each of the new orthogonal axes (for example, isolating the transverse and radial signal components). On this rotated vector matrix derived products are computed and displayable as shown in Table 21. *PolariPlot* also allows you to manually rotate the matrix and then compute the same derived products (for example after rotating the matrix to orient towards a known source) such as the event location under refinement in *ARS*. This allows you to compare the manual and automatic (eigenvector) solutions. *PolariPlot* computes and displays, by default, an amplitude graph, azimuth graph, and rectilinearity graph for the selected 3-C station over the specified time interval.

TABLE 21: TRACES AVAILABLE IN POLARIPLOT

Parameter	Description[1]
Component Amplitude	Computed by taking the square root of the sum of the squared component amplitudes.
Azimuth	Azimuth of the eigenvector associated with the largest eigenvalue (deg.).
Azimuth-LR (Raleigh-phase observed azimuth)	Azimuth of the eigenvector associated with the smallest eigenvalue (deg.).

TABLE 21: TRACES AVAILABLE IN POLARIPLOT (CONTINUED)

Parameter	Description[1]
Short Incidence	Apparent incidence angle measured from the vertical of the eigenvector associated with the smallest eigenvalue (deg.).
Planarity	Measure of the planar characteristic of the polarized ellipsoid.
Long Incidence	Apparent incidence angle from the vertical of the eigenvector associated with the largest eigenvalue (deg.).
Rectilinearity	Particle motion as a function of time.
Horizontal/Vertical Ratio	Horizontal-to-vertical power.
Radial/Transverse Ratio	Ratio of the radial to transverse component amplitudes.
Radial Component	Amplitude of the signal in the direction of the current event azimuth.
Transverse Component	Amplitude of the signal in the horizontal direction perpendicular to the current event azimuth.
Normal Component	Amplitude of the signal in the direction normal to the current event incidence angle.

1. Algorithms are provided in [IDC5.2.1].

See "Tools > PolariPlot" on page 141 for instructions on launching *PolariPlot*.

PolariPlot Window Layout and Organization

Figure 217 shows the *PolariPlot* window with three of the selectable traces described in the previous section. Menu items appear at the top of the window, parameter values appear above the graphs, and the graphs appear below.

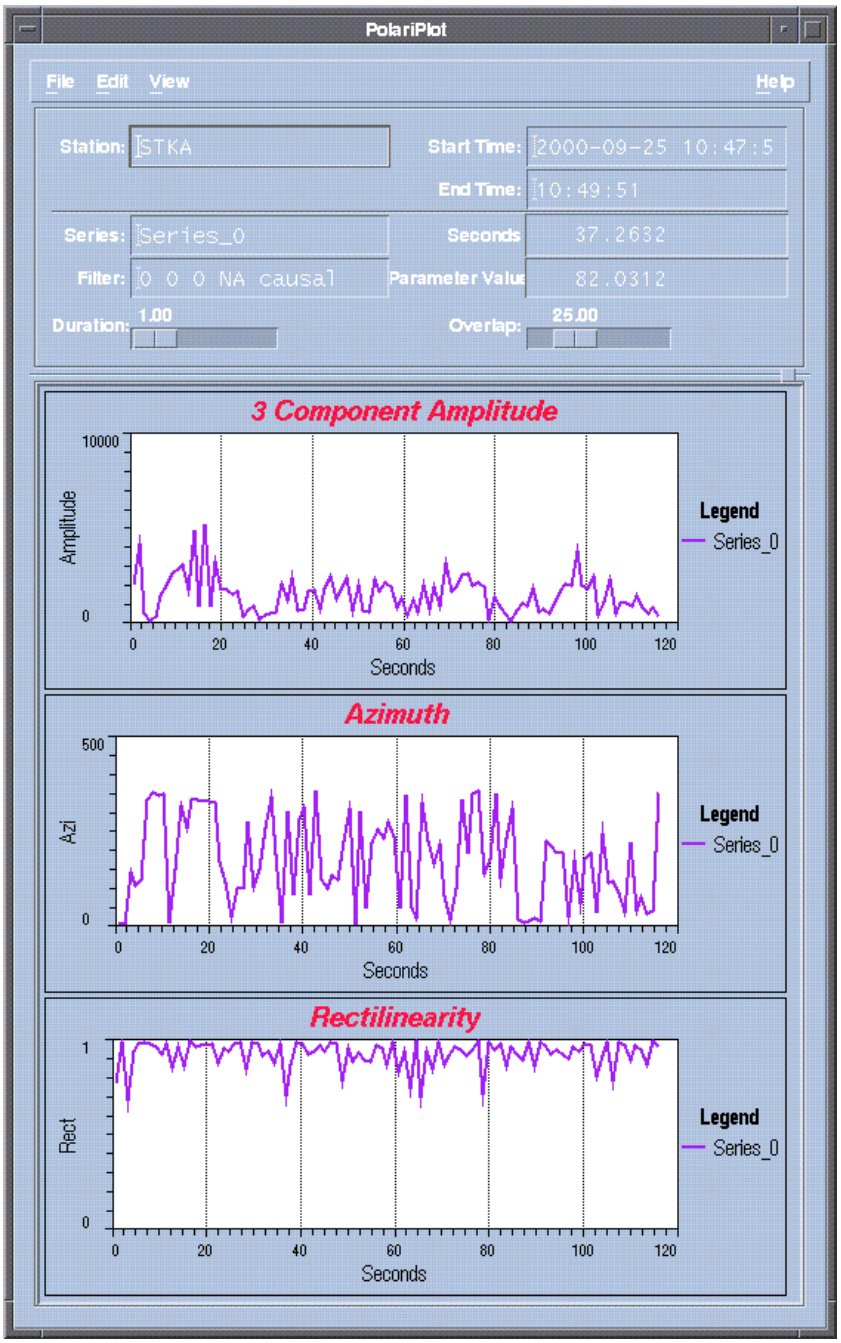


FIGURE 217. POLARIPLOT WINDOW

Figure 218 shows the parameter-value display in *PolariPlot*. The top section shows the station, start-time, and end-time of the time series sent from *ARS*. The section immediately below it is known as the Active Series display, which presents information about the polarization calculations currently displayed in the traces below. By moving the cursor over the graphs the Active Series section updates as the cursor moves to display the values represented by the current position of the cursor. Table 22 describes the fields.

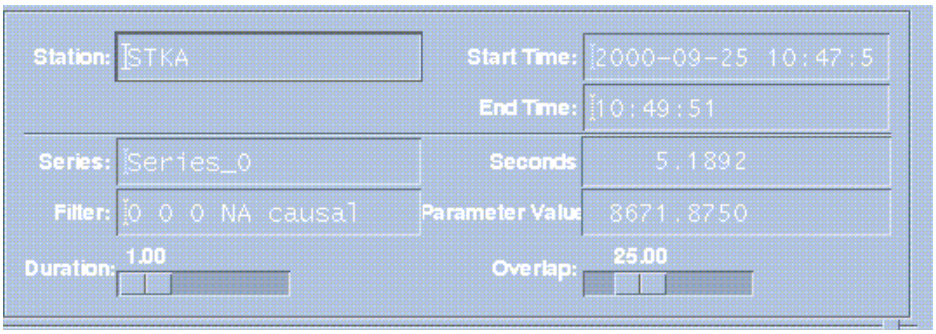


FIGURE 218. POLARIPLOT PARAMETER DISPLAY

TABLE 22: POLARIPLOT ACTIVE SERIES FIELDS

Field	Description
Series	Current series or data being displayed. By default, `Series_0` is created when data are first sent from *ARS*. New series, using different filters and settings, can be created through the File > New menu option.
Filter	Filter used for data displayed in the graph (unfiltered in Figure 218).
Duration	Duration (between 0.00 and 60 s) of the time windows used for polarization analysis.
Seconds	Time (x-axis) value of the cursor as it moves over the continuous trace.
Parameter Value	Parameter (y-axis) value represented by the cursor as it moves over the continuous trace.
Overlap	Overlap (between 0.00 and 100 percent) of the time windows used for polarization analysis.

Figure 219 shows the default graph traces in *PolariPlot*. These traces are calculated and displayed when data from a 3-C station are sent from *ARS*. The legend is shown on the right side of the traces and indicates the color and shape of the line representing the current series. More than one series can be displayed simultaneously in *PolariPlot,* and the Legend helps distinguish the overlapping traces.

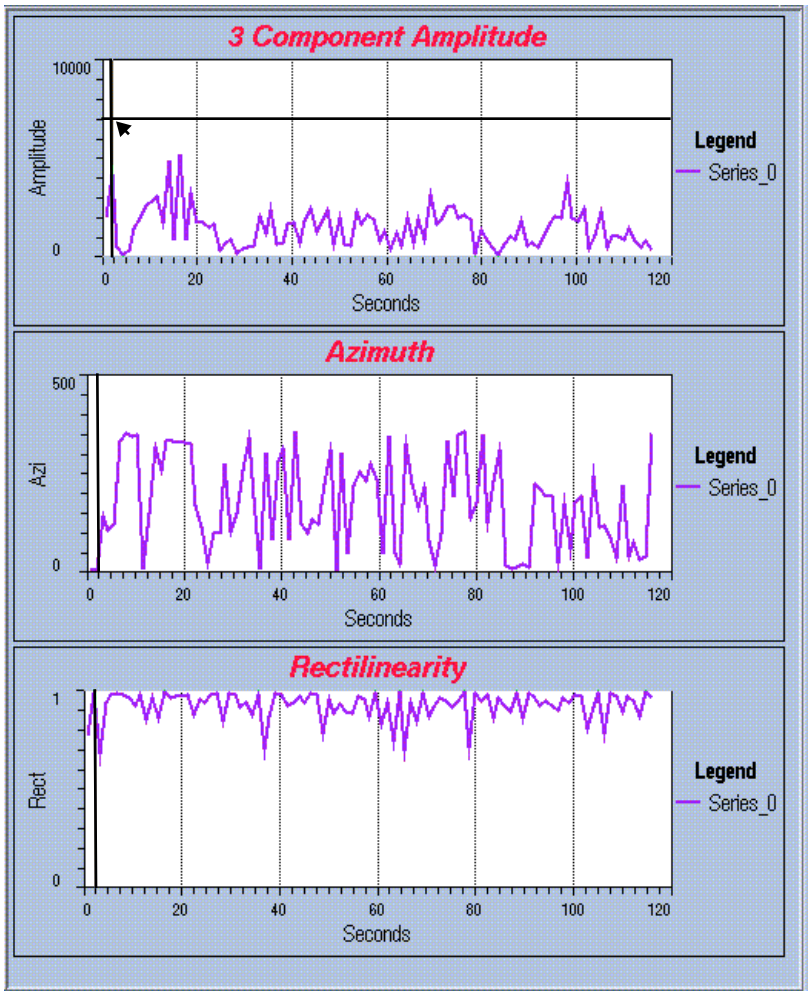


FIGURE 219.POLARIPLOT DEFAULT DISPLAY GRAPHS

The units for these three default graphs are as follow:

- Amplitude:

  x-axis (s)

  y-axis (nm)

- Azimuth:

  x-axis (s)

  y-axis (degrees from north)

- Rectilinearity:

  x-axis (s)

  y-axis (degree of rectilinearity, measured from 0 to 1)

When you place the cursor over any of the graphs, the cursor appears as a crosshair in the display. The cursor provides two important visual queues. First, the coordinates of the crosshairs are continuously updated in the parameter fields. This is useful for identifying features. Second, the vertical crosshair extends across all graphs and can be used to measure feature alignment on the time-axis. If the displayed graphs are not presented in the same time scale, the cursor may be used to observe how scale intervals on one graph correspond to intervals on the other graph. The arrow in the top portion of Figure 219 shows an example of the crosshairs representing the cursor.

PolariPlot Menus

PolariPlot has three menus (File, Edit, and View) that control the session, display data, and change settings. A fourth menu, Help, is inactive.

File Menu

The File menu shown in Figure 220 provides general application control options. You can start or end a *PolariPlot* session, print the *PolariPlot* window, or send parameter data to *ARS*.

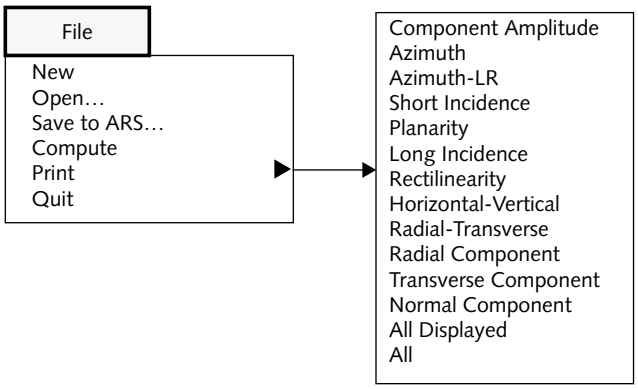


FIGURE 220. POLARIPLOT FILE MENU

File > New

The New menu option allows you to create a new series of data. The new series is created using the filtering, duration, and overlap parameters currently set in *PolariPlot*; these parameters should be set before you create a new series. The series are named sequentially as `Series_0`, `Series_1`, `Series_2`, and so forth. `Series_0` is the first series created automatically when data are first sent from *ARS*.

File > Open…

The Open… option opens a dialogue box from which you can select a graph series for display. Graph series are created through the New option.

To open a dialogue box:

1. Click on the desired series in the Graph field, and click OK.

   The selected series is displayed in *PolariPlot* and replaces the one currently displayed.

File > Save to ARS…

The Save to ARS… option sends parameter information to *ARS*. After you choose this option, *PolariPlot* displays a dialogue box, as shown in Figure 221. This dialogue box contains all the polarization parameters available either to be displayed or to be sent to *ARS*. Parameter information is calculated for all graph types whether displayed or not and therefore can be sent to *ARS* independently of their display status. (See Figure 228 and "View > Display…" on page 288 for the dialogue's display functionality.)

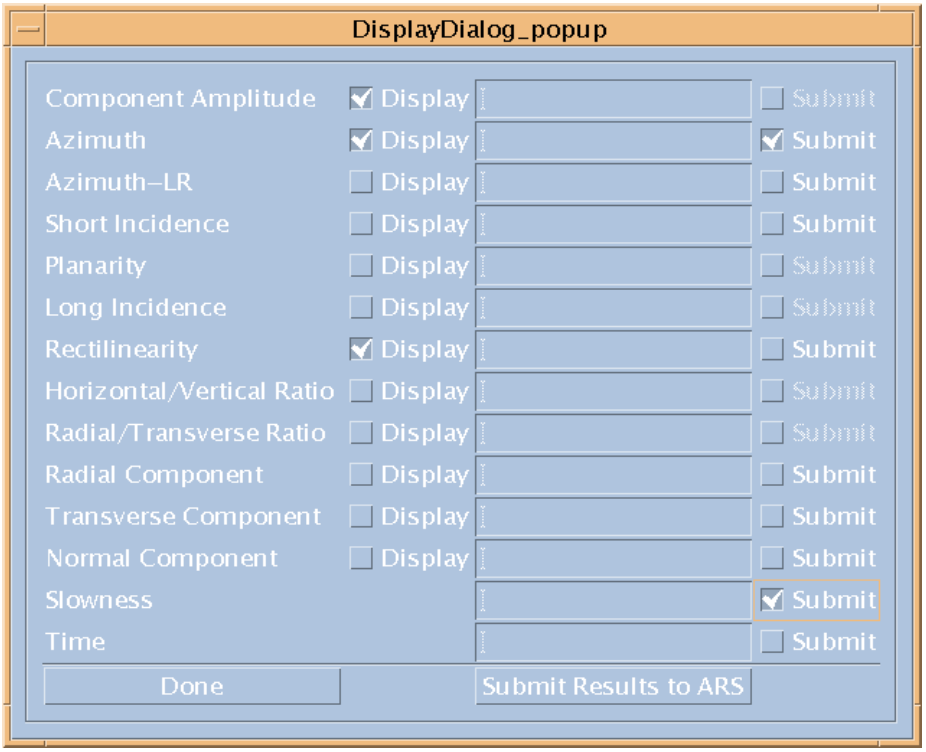


FIGURE 221.POLARIPLOT DISPLAY/SUBMIT DIALOG BOX

To submit parameter information to *ARS*:

1. Select the Submit box beside each desired parameter.

2. Choose File > Submit to ARS.

   The selected parameters are sent to *ARS*.

3. Click Done to undisplay the dialogue box.

File > Compute

If you have made adjustments to parameters affecting the display, either through menu functions or via the modifiable settings in the window area above the graphs, use the Compute option to generate new graph traces that incorporate the new settings.

File > Print

The Print option prints selected *PolariPlot* output to the default printer. The Print submenu options allow you to print individual polarization parameters, all currently displayed graphs, or all available graphs.

File > Quit

The Quit function exits *PolariPlot*.

Edit Menu

The Edit menu shown in Figure 222 provides options to modify the data displayed in the *PolariPlot* graphs.

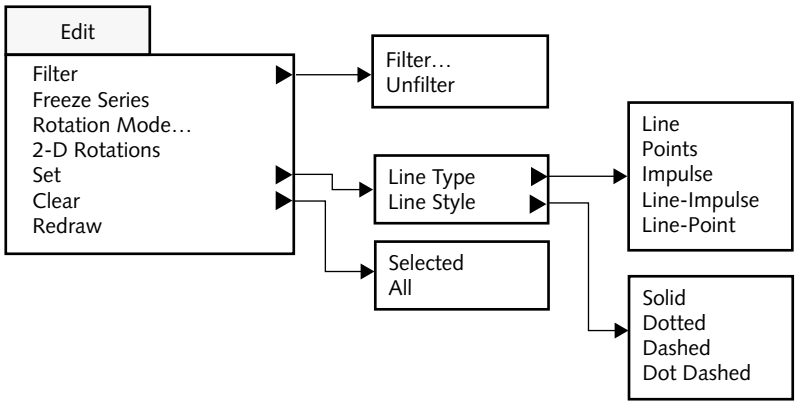


FIGURE 222.EDIT MENU

Edit > Filter

The Filter submenu shown in Figure 223 contains two options: one to specify filter settings and one to unfilter data.

FIGURE 223.FILTER SUBMENU

Edit > Filter > Filter…

The Filter… option displays a dialogue box for you to change the filter settings. You can tailor the filter in a number of ways, as shown in Figure 224.

- Scrollbars permit fine tuning of the high and low frequency boundaries.
- Multiplier tabs increase or decrease the frequency boundaries by orders of magnitude.
- A scrollbar permits changing the order of the filter up to an eighth order filter.

- A menu permits choosing among band pass, low pass, high pass, and band reject filters.
- A menu permits choosing between causal and non-causal filters.

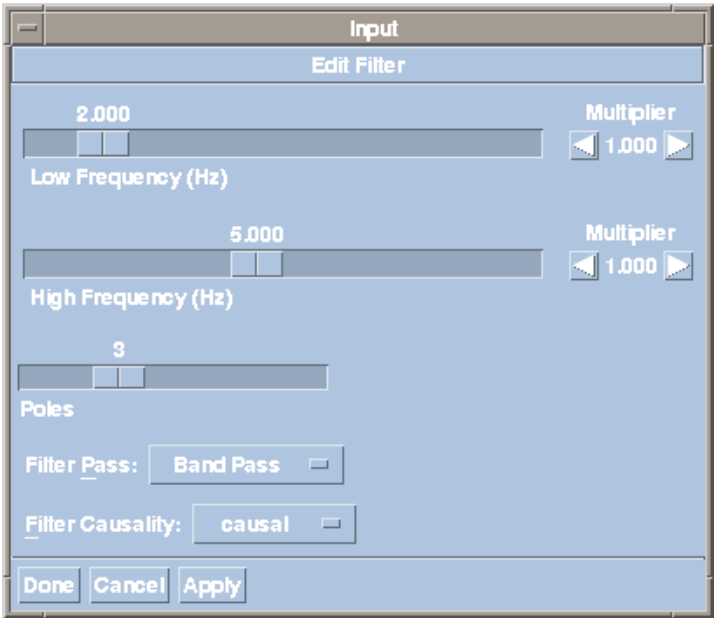


FIGURE 224.POLARIPLOT FILTER DIALOGUE BOX

When finished specifying filter settings, click Apply to apply the new settings and retain the window, click Done to apply the new settings and close the window, or click Cancel to close the window without applying the filter settings.

Edit > Filter > Unfilter

The Unfilter option removes filtering from all graphs in the current active series (displayed series).

Edit > Freeze Series

By default, when a new message is received from *ARS* the new data replaces the currently displayed data in *PolariPlot*. To preserve the current session so that it is not erased or overwritten by the incoming message, choose Edit > Freeze Series before sending a new message from *ARS*. Freeze Series is a toggle switch; if enabled, select it again to disable it.

Edit > Rotation Mode...

The Rotation Mode... option displays a dialogue box, which allows you to specify a manual rotation for the input orthogonal coordinates. This overrides the automatic eigenvector computation. Three options are available, as shown in Figure 225: rotate to the origin specified in the orid box, rotate to the latitude and longitude specified by two sliders, or rotate to the azimuth and incidence angles specified by two sliders.

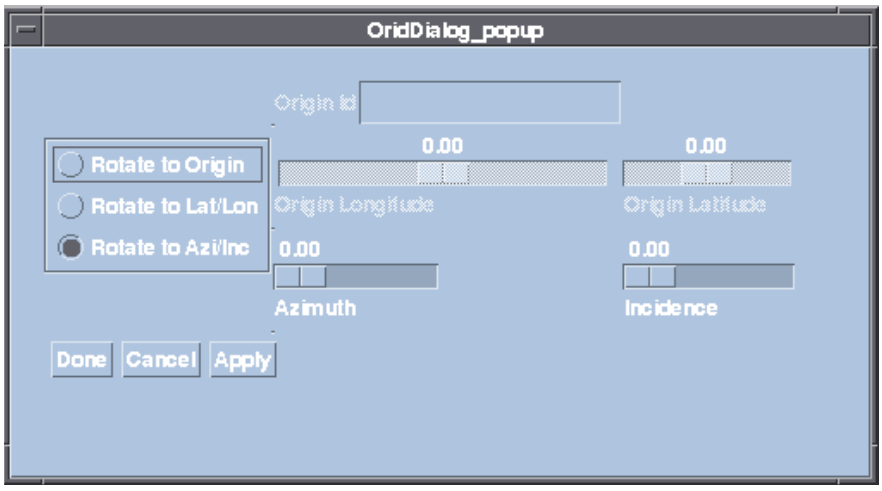


FIGURE 225. ROTATION MODE DIALOGUE BOX

Edit > 2-D Rotations

The 2-D Rotations option is a toggle that switches between two- and three-dimensional rotations for computing polarization analysis. When 2-D Rotations is enabled, the incidence angle is not considered in the rotation. You must choose File > Compute to update the graphs.

Edit > Set > LineType or Line Style

The Set submenu shown in Figure 226 allows you to change the graph display line type or line style formats.

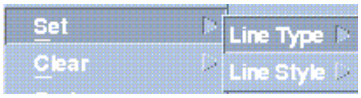


FIGURE 226.SET SUBMENU OPTIONS

The Set > Line Type option allows you to change the line format in the graphs to one of lines (default type), data points, impulse lines (bar graphs), combined lines and impulse lines, or combined lines and data points.

The Set > Line Style option allows you to change the graph line style to be a solid line (default style), a dotted line, a dashed line, or dot-dash line.

Edit > Clear

The Clear submenu options allow you to remove selected information from the graphs or to undisplay the graphs entirely.

Edit > Clear > Selected

The Clear > Selected option undisplays the current active series graphs. The graph areas remain blank.

Edit > Clear > All

The Clear > All option removes all information from the defined graph series in *PolariPlot*. The graph is erased, leaving blank plots.

Edit > Redraw

The Redraw option refreshes the graph area. By selecting Redraw, *PolariPlot* and its associated graphs are redrawn.

View Menu

The View menu shown in Figure 227 allows you to change the way that data are displayed in *PolariPlot* or to change its display properties.

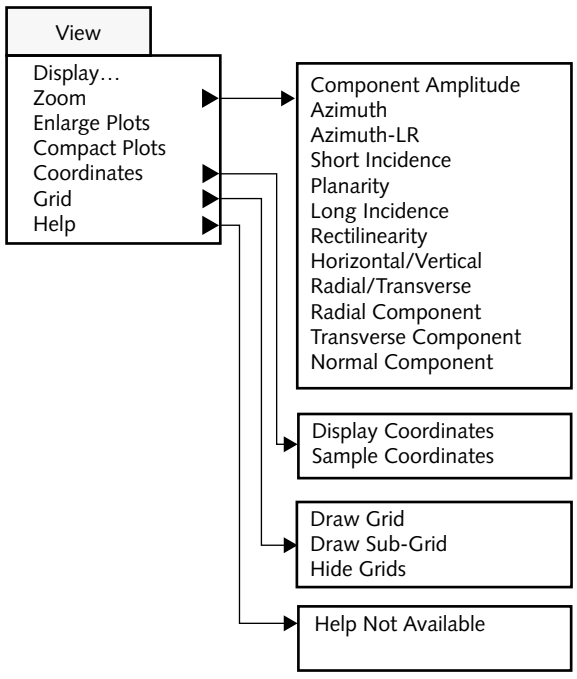


FIGURE 227.POLARIPLOT VIEW MENU

View > Display…

The View > Display… option brings up a list of graph types that can be selected for display, as shown on the left side of Figure 228. A description of the available graph types is presented in Table 21 on page 274. You can choose to display one or more graphs by selecting the Display box beside each desired graph type. Click Done to display the selection of graphs. By default, amplitude, azimuth, and rectilinearity are displayed. (The right side of Figure 228 is described in "File > Save to ARS…" on page 281.)

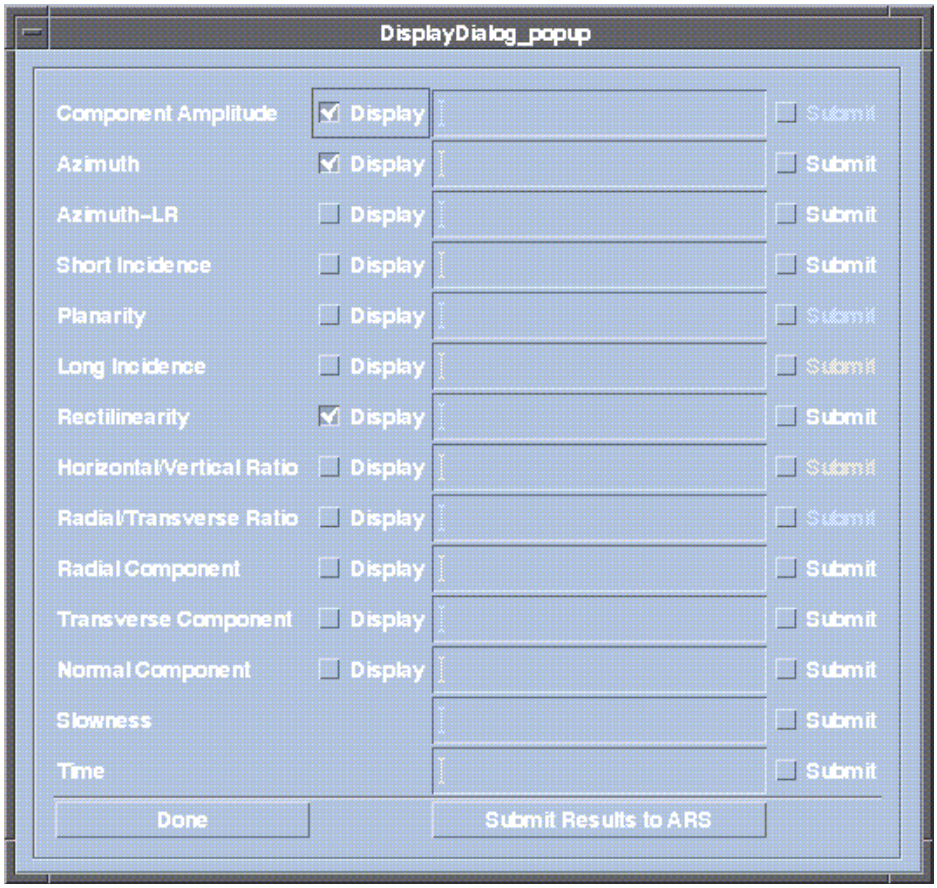


FIGURE 228.POLARIPLOT GRAPH DISPLAY OPTIONS

View > Zoom

The Zoom submenu shown in Figure 229 enables zooming on the selected graph type.

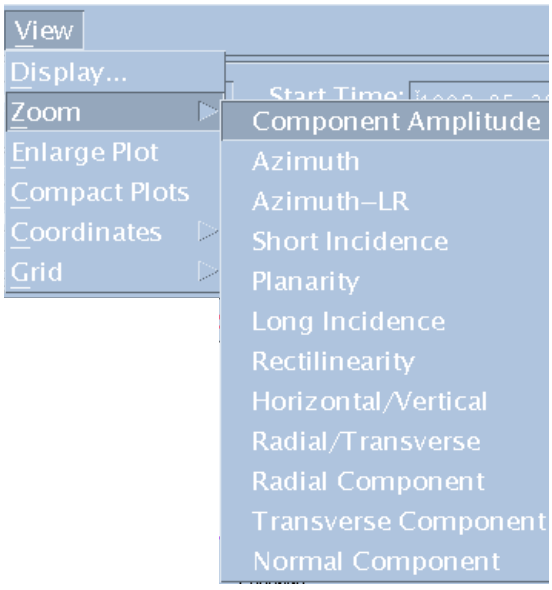


FIGURE 229. VIEW > ZOOM SUBMENU

To zoom into a sub-section of the Component Amplitude graph: (for example)

1. Choose View > Zoom > Component Amplitude.
2. In the Component Amplitude graph use the left-most button to click and drag a rectangle around the desired graph segment to enlarge. Release the mouse button.

   The enclosed graph segment in the Component Amplitude graph is redrawn to occupy the entire width of the graph area.
3. Choose View > Zoom > Component Amplitude again to exit the zoom mode.

View > Enlarge Plot

The Enlarge Plot option redraws the displayed graphs in a larger vertical size so that only one of the current graphs fills the current *PolariPlot* graph area.

View > Compact Plots

The Compact Plots option redraws all graphs in the current display in a smaller vertical size so that three of the current graphs simultaneously fit in the *PolariPlot* graph area.

View > Coordinates

The Coordinates submenu shown in Figure 230 provides two mutually exclusive options for displaying coordinate values in the Active Series parameter fields above the graph area.

FIGURE 230. COORDINATES DISPLAY OPTIONS

View > Coordinates > Display Coordinates

The Display Coordinates option displays the polarization coordinates continuously as the cursor moves over the graph. This is the default coordinate display method.

View > Coordinates > Sample Coordinates

The Sample Coordinates option updates the polarization coordinates in the parameter field only when you click the left mouse button within the graph area. When you click within a graph, a vertical line is also drawn at the selected position.

View > Grid

The Grid submenu option shown in Figure 231 selects the style of grid that is superimposed on the current graphs.

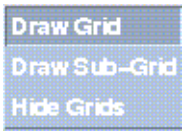


FIGURE 231.THREE GRID STYLES AVAILABLE FOR DISPLAY IN POLARIPLOT

View > Grid > Draw Grid

The Draw Grid option draws a reference grid on the current graph. The grid is composed of three vertical lines for reference. This is the default grid in *PolariPlot*.

View > Grid > Draw Sub-Grid

The Draw Sub-Grid option draws a more dense grid than the default grid.

View > Grid > Hide Grids

The Hide Grids option removes all displayed grids from the current graphs.

SPECTRAPLOT PROCEDURES

SpectraPlot is a tool that calculates and displays a waveform segment's spectrum. The spectrum is defined as the power density (in dB) expressed over the frequency range of the sampled waveform. This tool is often used to identify the peak or dominant frequency of a signal, or for comparing an arrival's signal to background noise by using a waveform segment just ahead of the signal's onset, or to find regions of high snr to optimize filtering for viewing or FK analysis.

SpectraPlot Window Layout and Organization

The *SpectraPlot* display is shown in Figure 232.

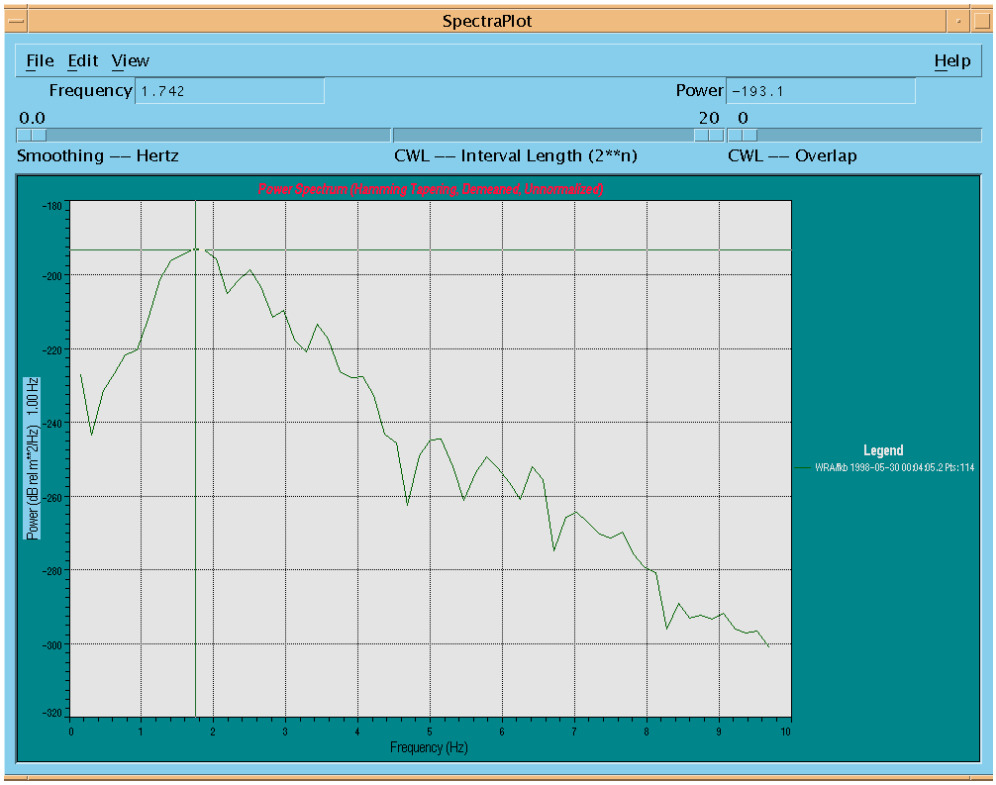


FIGURE 232. SPECTRAPLOT DISPLAY WITH LINEAR FREQUENCY

SpectraPlot operates by accepting waveform data sent from *ARS*, computing the spectral characteristics, and plotting power as a function of frequency. *SpectraPlot* can display up to 20 spectra. Individual spectra are displayed in different colors. See "Tools > SpectraPlot" on page 142 for instructions on sending data to *SpectraPlot* from *ARS*.

File Menu

The File menu shown in Figure 233 provides general functions for the *SpectraPlot* display. The functions are described in Table 23.

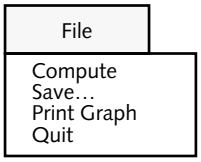


FIGURE 233.SPECTRAPLOT FILE MENU

TABLE 23: FILE MENU FUNCTIONS

Function	Description
Compute	Recalculates and redraws the currently displayed spectra based on changes to parameters.
Save…	Saves spectra to a file.
Print Graph	Prints the currently displayed spectra.
Quit	Exits *SpectraPlot.*

File > Compute

The File > Compute function must be used frequently to force recalculation of the spectrum currently displayed in the *SpectraPlot* display. When settings available through the Edit or View menus are modified, the spectrum are only recalculated and redrawn after Compute is selected. This is especially true where parameters, such as smoothing and normalizing, are changed while the spectrum is still displayed. To recompute the spectrum with changed display parameters, first change the required parameters, and then select Compute.

To recalculate the displayed spectrum:

1. Choose an option from the Edit menu. For example, choose Edit > Normalize.

   Nothing happens after Normalize is selected. The screen updates only after Compute is selected. The spectra normalizes with 0 dB as the highest decibel level in the window.

2. Choose File > Compute.

Edit Menu

The Edit menu shown in Figure 234 provides options for editing the spectra's computation. The functions are described in Table 24.

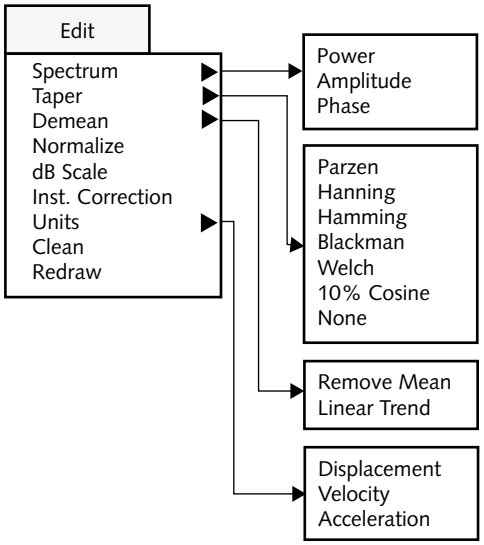


FIGURE 234.SPECTRAPLOT EDIT MENU

TABLE 24: EDIT MENU FUNCTIONS

Header Function	Sub-function	Description
Spectrum[1]	Power	Displays the waveform's power spectrum.
	Amplitude	Displays the waveform's amplitude spectrum.
	Phase	Displays the waveform's phase spectrum.
Taper	Parzen	Computes spectrum using the Parzen taper.
	Hanning	Computes spectrum using the Hanning taper.
	Hamming	Computes spectrum using the Hamming taper.
	Blackman	Computes spectrum using the Blackman taper.
	Welch	Computes spectrum using the Welch taper.
	10% Cosine	Computes spectrum using the 10 percent Cosine taper.
	None	Does not taper the waveform when computing a spectrum.
Demean	Remove Mean	Subtracts the average value of the sampled waveform before computing the spectrum.
	Linear Trend	Subtracts the best fit line from the waveform data before computing the spectrum.
Normalize		Normalizes the spectra; assigns the highest value (power of 0 dB).
dB Scale[1]		Changes the power axis (vertical axis) from a dB scale to a nm^2/Hz scale.
Inst. Correction		Applies an instrument correction to the currently displayed spectrum (the instrument correction reference is provided by *ARS*).

TABLE 24: EDIT MENU FUNCTIONS (CONTINUED)

Header Function	Sub-function	Description
Units	Displacement	Displays the spectral power units of displacement.
	Velocity	Displays the spectral power units of velocity.
	Acceleration	Displays the spectral power units of acceleration.
Clear		Removes all displayed spectra from the display.
Redraw		Refreshes the display by redrawing the currently displayed spectra.

1. You must choose File > Compute to recalculate and update the display after invoking these menu options.

View Menu

The View menu (Figure 235) offers options to change the display of spectra. Table 25 presents the functions listed under the View menu, with a brief explanation of each.

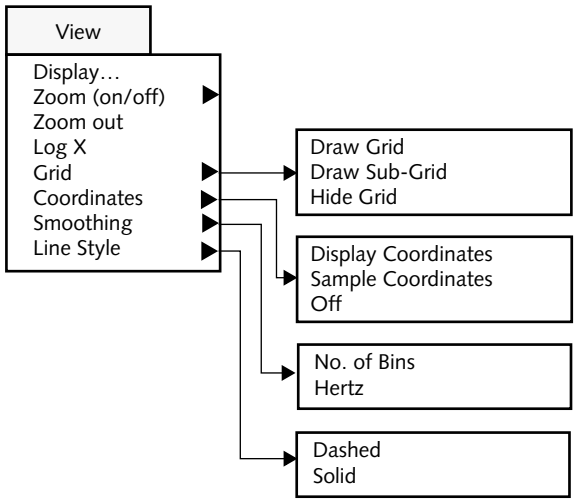


FIGURE 235.SPECTRAPLOT VIEW MENU

TABLE 25: VIEW MENU FUNCTIONS

Header Function	Sub-function	Description
Display…		Displays a list of spectra available for display in *SpectraPlot*. To display a graph, select it, and then select Show. To undisplay a graph, select the spectrum, then select Hide.
Zoom (on/off)		Allows you to zoom in or out of a plot. Use the left mouse button to drag a rectangle around the desired feature. Release the mouse button, and the graph will be redrawn, enlarging the selected area.
Zoom Out		Zooms out from the current display. When selected this option zooms out from the vertical axis by a factor of two and by one order of magnitude when the x-axis is in logarithmic display mode.
Log X		Toggles between a logarithmic and a linear x-axis display (an example linear plot display is shown in Figure 232 and a log plot in Figure 236).
Grid	Draw Grid	Displays grid lines superimposed on the spectral display.
	Draw SubGrid	Displays a more detailed grid than the Draw Grid option.
	Hide Grids	Undisplays the grid display.
Coordinates	Display Coordinates	Displays the coordinates of the cursor on the graph. The coordinates change as the cursor is moved around the display.
	Sample Coordinates	Displays the coordinates represented by the cursor's position when the left mouse button is clicked.
	Off	Turns off the coordinates display.

TABLE 25: VIEW MENU FUNCTIONS (CONTINUED)

Header Function	Sub-function	Description
Smoothing	No. of Bins	Changes the smoothing units to number of bins.
	Hertz	Changes the smoothing units to number of Hertz.
Line Style	Dashed	Displays the plotted spectra as a dashed line.
	Solid	Displays the plotted spectra as a solid line.

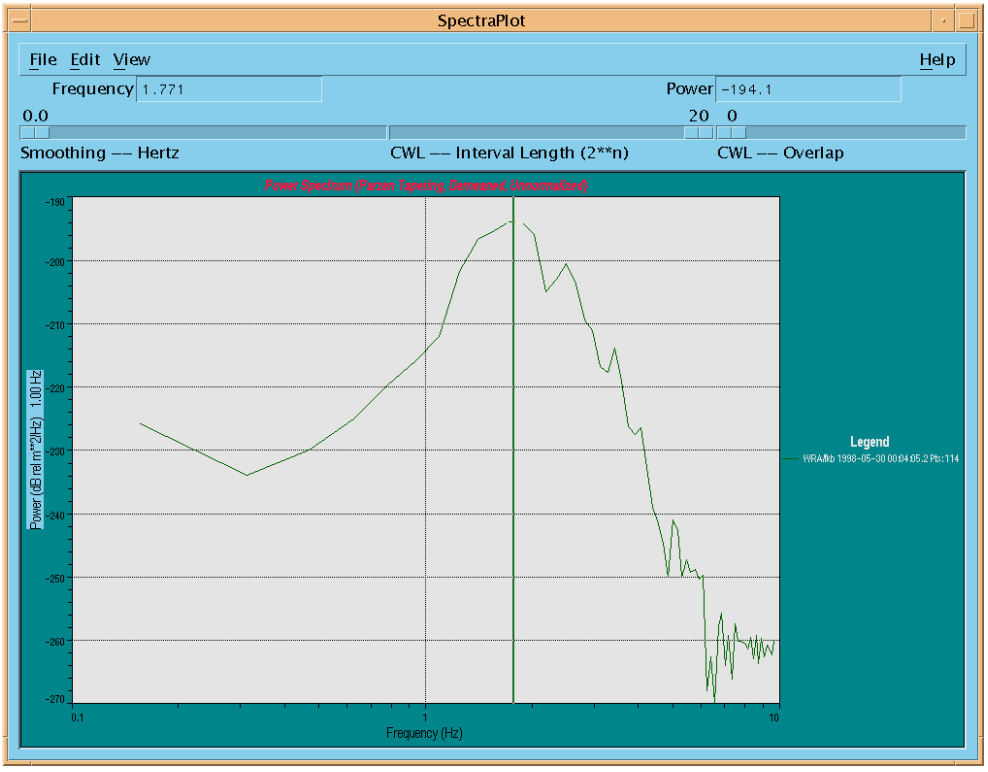


FIGURE 236.SPECTRAPLOT DISPLAY WITH LOG FREQUENCY

Main Window Parameters and Controls

Frequency and Power

The Frequency and Power parameter display fields show the coordinates of the cursor as it moves around the spectra display. The View > Coordinates submenu controls how these fields are updated. By default the View > Display… option is selected, and these fields update continuously. If the Select option is selected, the fields only update when the left mouse button is clicked in the graph area. The Off option disables the update.

Smoothing

Smoothing reduces the amount of data scatter in a spectrum by averaging the spectrum over a number of adjacent frequency bins. The spectra lose detail as a larger number of frequency bins are used for smoothing. Figures 237 and 238 show the difference between an unsmoothed and a smoothed plot, respectively.

Choose File > Compute to recompute the spectra and display the changes.

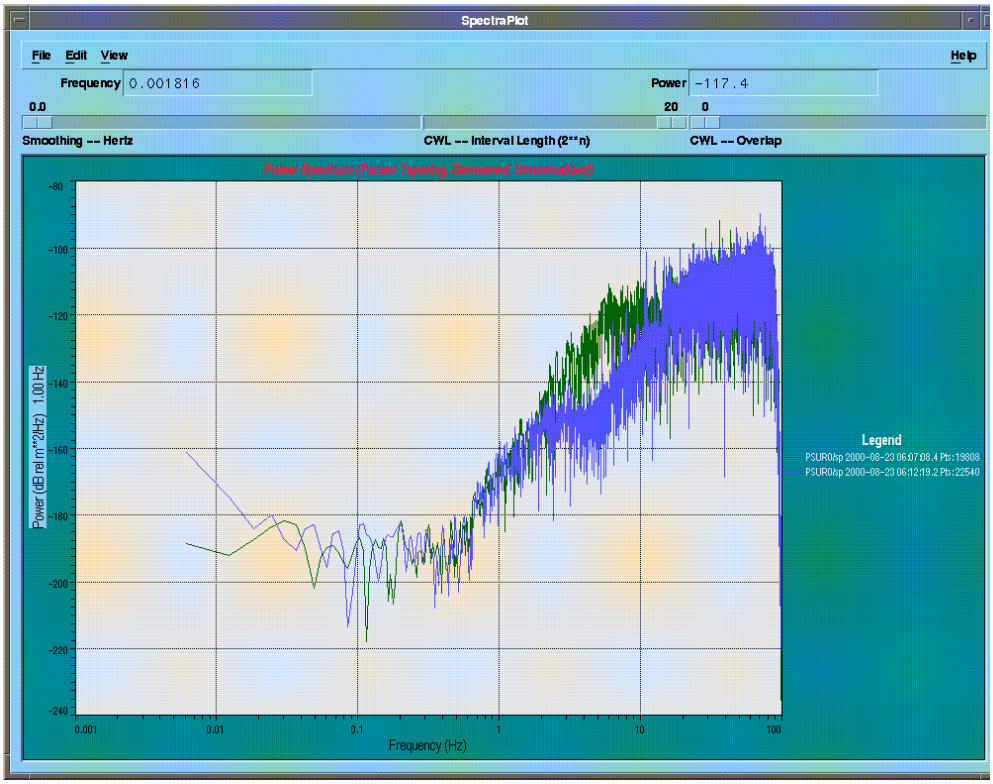


FIGURE 237. SPECTRAPLOT DISPLAY OF UNSMOOTHED SPECTRA

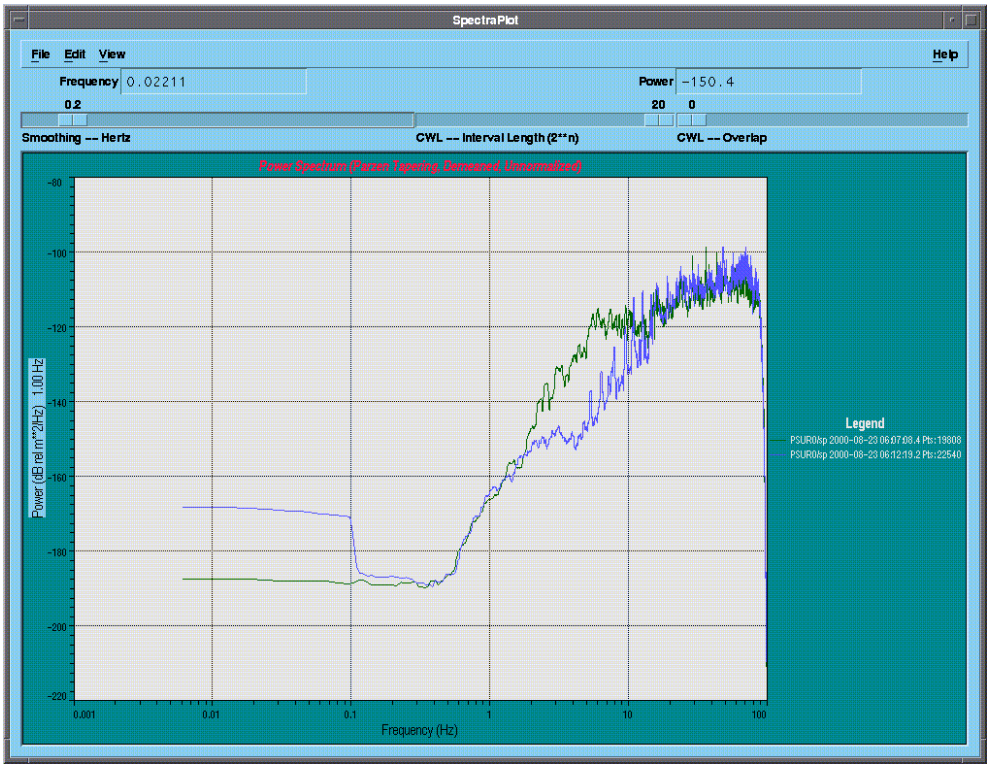


FIGURE 238. SPECTRAPLOT DISPLAY OF SMOOTHED SPECTRA

CWL – Interval Length (2^n) and Overlap

Another smoothing method, the Cooley-Welch-Lewis (CWL) method, estimates sections of the overall spectrum, then averages them together. The scroll bars provide options to control the length of each segment and the overlap of the segments as they are averaged together.

DMAN PROCEDURES

dman is a tool that monitors interprocess communication messages sent between *ARS* and its associated tools. *dman*'s primary responsibility is to make sure that all applications to which messages are sent are running. For example, working within *ARS* you can display the location of an event in the *Map* application by using the *ARS* Tools option to send the data to *Map*. Without further action by you, *Map* starts and displays the data. In the background, *dman* monitors the message from *ARS* to *Map*, detects that *Map* was not currently running, and starts *Map* so it can respond to the message. In addition to monitoring message traffic, *dman* also provides a window, which displays the run state and message queue size for each application. From within this window you can manually start and stop applications and clear application message queues.

Message queues on each analyst workstation are maintained by the Tuxedo interprocess communication framework (see [IDC6.5.2Rev0.1]). All of the applications use common software libraries to communicate using the Tuxedo framework. As a Tuxedo client *dman* presents data maintained by the Tuxedo framework in its status window. A detailed description of Tuxedo as it applies to the interactive subsystem is presented in "Tuxedo Files" on page 353 in Chapter 4.

Each analyst workstation can support up to three simultaneous *ARS* sessions identified by agent numbers one through three. Each session has its own *dman* application tracking the other applications for that session. The window title in Figure 239 shows "1:dman" identifying this *dman* as monitoring activity for session 1.

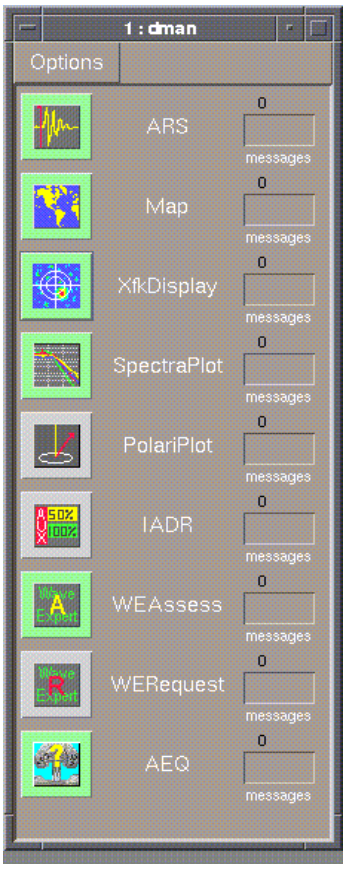


FIGURE 239. DMAN STATUS WINDOW

The *dman* window displays the current run status for each application in a session. The icon beside each application name changes color based on the application's status. Table 26 lists the colors representing the different application states. A graph, which shows the number of messages in its message queue, is displayed to the right of each application name. This number is usually zero because messages are processed very rapidly. However, queue sizes that remain above zero indicate problems.

TABLE 26: DMAN COLOR SCHEME

color	Definition
green	The process is running.
grey	The process is not running.
yellow	The process is starting.
orange	The process is stopping normally.
red	The process has abnormally exited or timed-out during startup.
black	*dman* has polled the application and has found that it is no longer running, but has no indication as to why it has stopped running.

Initializing dman

Analyst sessions are started through *analyst_log* using the *ARS* icon button. By default the session is started using agent 1, but this can be set to a different agent number, (see "analyst_log Procedures" on page 312). When *analyst_log* starts a session it starts *dman,* which in turn is configured to start *ARS* and *WEAssess*. *dman* then starts the other applications when necessary.

To start an analysis session:

1. Click the *ARS* button in *analyst_log*.

   dman launches. In the *dman* window, notice the icons for *ARS* and *WEAssess* turning yellow and then green. This indicates that *ARS* and *WEAssess* have been launched. The *ARS* window displays on the left screen.

You can also launch *dman* through the CDE menu. The *dman* option in CDE is located in a pull-up menu above the Start Analyst Review button.

Options Menu

The only menu in *dman* is the Options menu. Table 27 describes the functions in this menu.

TABLE 27: OPTIONS MENU

Function	Description
Quit *dman*	Exit *dman*. A dialogue box appears to confirm before exiting.
Kill All	Stops all application processes, exits them, and exits *dman*. A dialogue box appears to confirm before exiting.
Query Queues	Immediately updates the displayed message queue sizes for all applications.
Show Log	Provides a limited history of actions performed and monitored by *dman*.
Hide Log	If the *dman* log is displayed, this option toggles to undisplay the log.

Starting Applications Manually

You can initiate an application by sending a message through *ARS* or by starting the application manually through *dman*. When a message is sent from *ARS*, the application launches and processes the message; when starting the application from *dman*, the application launches and then waits for messages.

To manually start an application (for example, *AEQ*):

1. Click on the *AEQ* application icon in *dman*.

   The icon turns yellow as it is initialized, as shown in Figure 240. It then turns green when *AEQ* becomes ready to use.

dman uses UNIX system commands to launch applications. It turns the icon yellow when it issues the system command. *dman* turns the icon green when it receives notification from Tuxedo that the application is ready to receive messages. If the application does not start within 30 seconds, *dman* turns the icon red to indicate a problem.

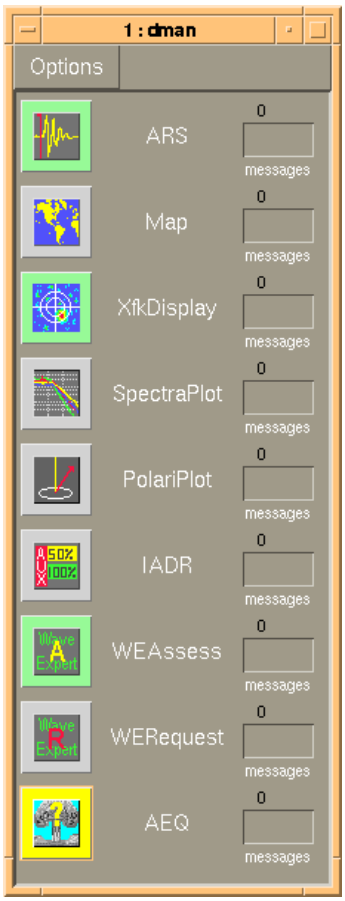


FIGURE 240.DMAN STATUS WINDOW WITH AEQ APPLICATION LAUNCHED

Stopping Applications in dman

In addition to stopping an application through the application's exit menu option you can stop an application through *dman*.

To stop an application such as *AEQ* in *dman*:

1. With the *AEQ* application running, click the *AEQ* application's icon in *dman*.

   dman prompts you to confirm by displaying the message: `Really kill AEQ?`

2. Click OK to continue, or click Cancel to keep the application running.

   The *AEQ* application exits. The icon in *dman* turns orange and then turn gray to indicate that it has stopped running.

For manual exits, *dman* sends a terminate signal to the application and then turns its icon orange. *dman* turns the icon gray when it receives notification from Tuxedo that the application is no longer ready to receive messages.

Message Queue in dman

When a message is sent from *ARS* to an application, it is placed in the application's message queue. The application then retrieves the message from its queue and processes it. *dman* monitors the number of messages in queues for all applications in that session. Message queue status is presented in the form of a bar graph that tracks changes to the number of messages in the application's queues. The number of messages is also reported textually on top of the bar graph. For example, the *XfkDisplay* message queue in Figure 241 shows six unread messages.

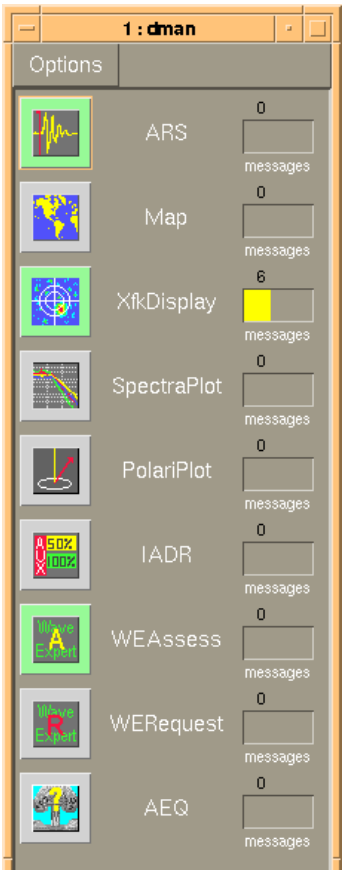


FIGURE 241.DMAN MESSAGE QUEUE

Normally, messages travel so quickly from *ARS* through the queue to an application that it is difficult to follow individual messages let alone prevent their processing. However, *dman* does allow you to remove messages from individual application message queues. This rare procedure is only needed if there are problems and the messages in the queue have become obsolete.

To clear a message queue:

1. Click directly on the application's queue size-bar graph.

   dman uses Tuxedo to delete the messages in the application queue so they will not be processed. This is also known as flushing the queue.

2. Using the left mouse button, click directly on the application's queue size bar graph (where the number of messages is displayed in *dman*).

   dman presents a confirmation dialogue box, as shown in Figure 242, prompting you to confirm the deletion of the messages.

3. Click OK to delete the messages from the queue. (Select Cancel to abort the operation and retain the messages.)

   All messages are deleted from the application's message queue, and they are no longer available for processing.

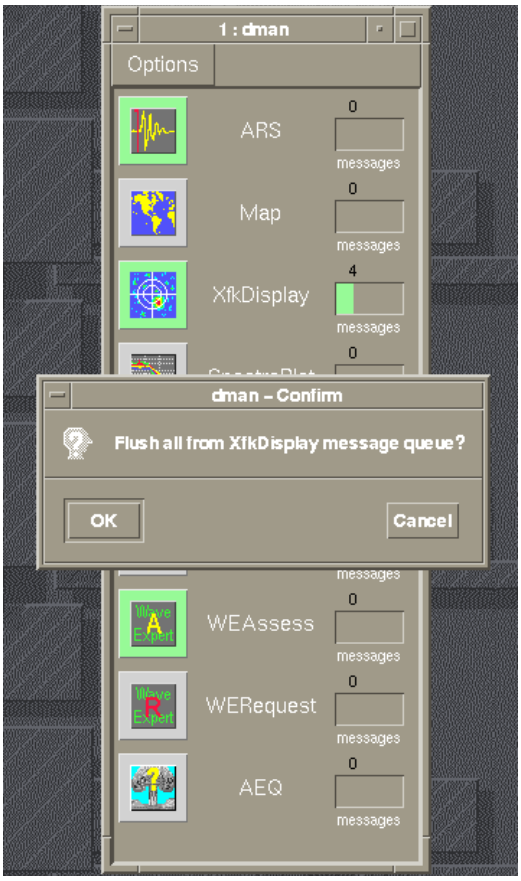


FIGURE 242. FLUSHING XFKDISPLAY'S MESSAGE QUEUE

Stopping Analysis through dman

To finish an analysis session, you can stop each application through its own Exit menu option, or you can terminate all applications through a single invocation of the *dman* Kill All option.

To kill all applications at once:

1. Choose Options > Kill All in *dman*.

   dman prompts you to confirm the operation by displaying the message: `Kill all Applications and Quit dman?`, as shown in Figure 243.

2. Click OK to continue. (Click Cancel to abort the operation and keep the applications running.)

   dman sends terminate commands to applications in the session. The icons for all running applications turn orange and then gray as each exits. When the last application has terminated, *dman* exits.

FIGURE 243.EXITING ANALYSIS SESSION

ANALYST_LOG PROCEDURES

analyst_log is the first tool used to begin an analysis session and the last tool used to complete an analysis session. *analyst_log* is used to reserve a time block for analysis, to create a parameter file that *ARS* will access to load data, to launch *ARS* for data analysis, to run quality checks at the end of an analysis session, and to signal that an analysis session has been completed, which triggers post-analysis automatic processing.

analyst_log is initiated by selecting Start Analyst Review in the CDE toolbar, (see "Software Startup" on page 18). The first window that appears is the control window shown in Figure 244, from which the Allocation, QC, and Exit options can be selected.

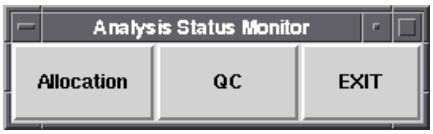


FIGURE 244.ANALYST_LOG CONTROL WINDOW

The Allocation window is the primary window used by analysts. The capabilities described in the introduction above are all accessed through this window. The QC window is primarily used to review a whole day's analysis. This window is discussed in "QC" on page 325.

Allocation Window

To access the Allocation window, click the Allocation button in the *analyst_log* Control window. The Allocation window is displayed as shown in Figure 245. Most of the window is occupied by a tabular representation of the 24 hours covering one day's analysis or dataday. The columns represent analysis milestones. Some of the cells may be highlighted and contain an analyst's name. Each analyst's *analyst_log* accesses a common **allocate_hour** database table to reserve time blocks for analysis. When any analyst reserves a time block, all *analyst_logs* will highlight the reserved block and show the name of the reserving analyst. A more detailed look at the allocation window follows.

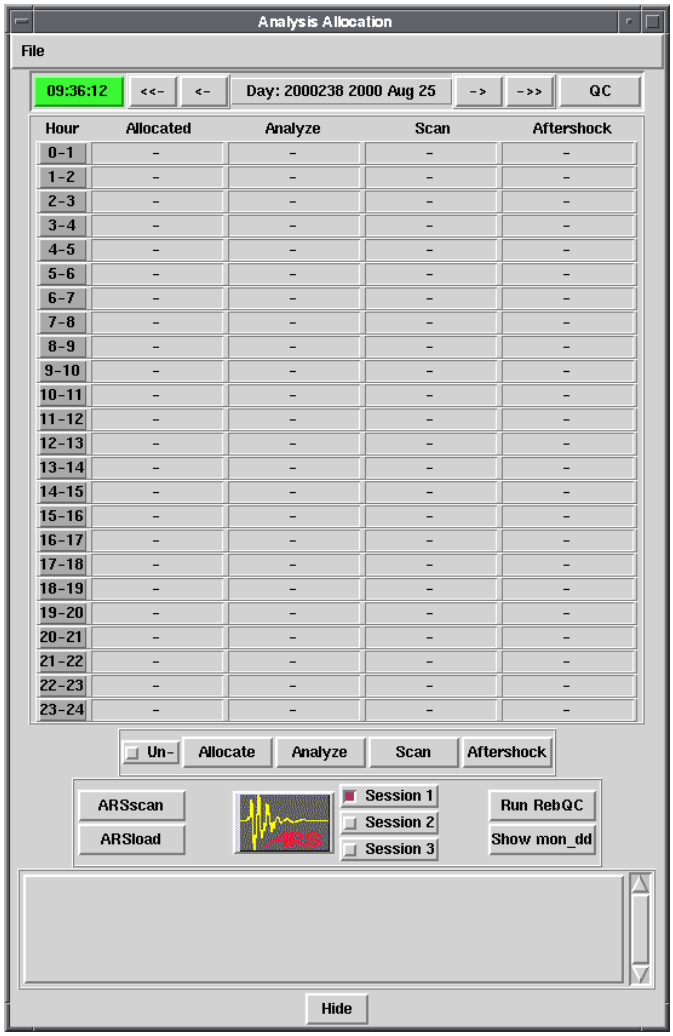


FIGURE 245. ALLOCATION WINDOW

The top of the Allocation window, as shown in Figure 246, contains the current time, scroll buttons to move from one dataday to another, and the date of the displayed window. It also contains a button to open the QC window. Table 28 describes the features in this portion of the *analyst_log* window.

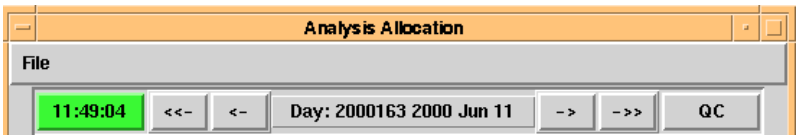


FIGURE 246. ALLOCATION WINDOW DATE AND TIME SECTION

TABLE 28: FEATURES IN TOP SECTION OF ANALYST_LOG

Feature	Description
<time>	Displays the current time, using color to show database connection status: ■ green — database connection is active; time is updated ■ yellow — intermediate; click the time to make analyst log active ■ blue — analyst_log is sleeping and database connection is inactive; click to activate
<<-	Scrolls the Allocation window back one week from the currently displayed dataday.
<-	Scrolls the Allocation window back one dataday.
Day:…	Displays Julian and regular date of current dataday; this date field updates as you scroll through datadays.
->	Scrolls the Allocation window forward one dataday.
->>	Scrolls the Allocation window forward one week from the current dataday.
QC	Opens the QC window.

The **allocation** table in the middle of the Allocation window is used to reserve a time period for analysis and to signal completion of the various analysis milestones: regular analysis, scanning, and aftershock analysis. Table 29 describes the columns in the **allocation** table. Allocated and completed hours are identified by the name of the analyst that reserved or completed an analysis step, while unreserved or uncompleted hours are empty. Figure 247 shows an unreserved time block in the

allocation table. To reserve hours, select open hours, and then click the Allocate button below the allocation table. Individual hours are selected from the Hour column using the mouse. Selected hours are highlighted in green and are usually left selected for the duration of analysis. As analysis milestones are completed, the Analyze, Scan, and Aftershock buttons below the allocation table are used to signal completion. These buttons, along with the Allocate button, are described in more detail below. Figure 248 shows a time block with time allocated (reserved), analyzed, and scanned by an analyst. Aftershock analysis was not performed for this time period.

TABLE 29: TIME ALLOCATION SECTION OF ANALYST_LOG

Heading	Description and Use
Hour	Displays 24 hours of the current dataday. Selected hours are shown in green.
Allocated	Displays the names of the analysts for the hours they have allocated (reserved) for analysis.
Analyze	Displays the names of the analysts when they complete analysis for allocated hours.
Scan	Displays the names of the analysts when they complete scanning for allocated hours.
Aftershock	Displays the names of the analysts when they complete aftershock analysis for allocated hours.

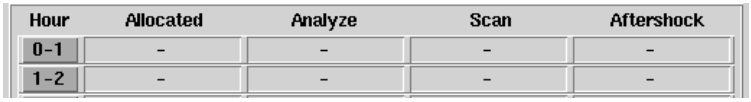


FIGURE 247.UNALLOCATED TIME BLOCK

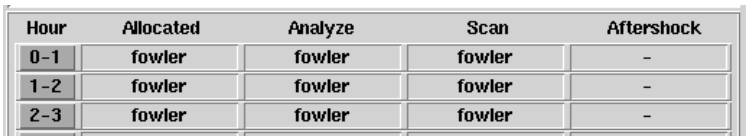


FIGURE 248. ALLOCATED, ANALYZED, AND SCANNED TIME BLOCK

Function Buttons

Two function button areas are displayed below the allocation table, as shown in Figure 249. The top row of function buttons pertain to individual columns of the allocation table, while the lower set provides more generalized functionality based on the hours selected in the allocation window.

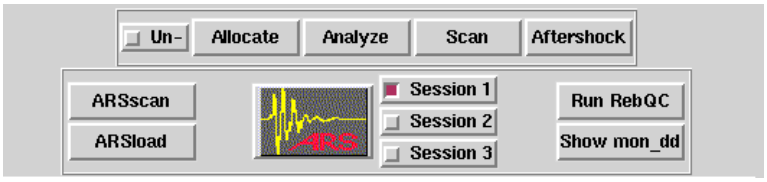


FIGURE 249. FUNCTIONS IN ANALYST_LOG

Un-

The Un- button is used in conjunction with the Allocate, Analyze, Scan, and Aftershock buttons. It reverses the action of these buttons. Un- is used to remove an analyst's name from an allocated cell, in other words, to de-allocate the cell. Using this capability to unreserve an allocated, but un-analyzed hour or time block is its normal intent. Use caution to un-complete a milestone column. Signaling completion of an analysis milestone triggers initiation of post-analysis processing on the selected time block. Un-signaling after post-analysis processing has begun can have adverse impacts and lead to database inconsistencies.

To Un-do a function:

1. Select the hours in the Hour column from which your name should be removed.
2. Click the Un- button.

   The toggle box turns red.
3. Click the Allocate button.

   Your name disappears from the Allocation column for the selected time interval, freeing up the hours for another analyst.

Only the analyst who has allocated a time period can remove their name from it.

Allocate

The Allocate function allocates a time period to be analyzed.

To Allocate a time period:

1. Select one or more hours in the Hour column, clicking on each desired hour consecutively with the left mouse button.

   Each selected hour turns green.
2. Click the Allocate button.

   When you select the hours and click Allocate your name is displayed in the Allocate column beside the requested hours. Your name also appears in the same cells in other analyst's Allocation windows. Thus you have signaled to the other analysts that these hours are reserved. No other analyst can reserve these hours, although any analyst can load any time period into *ARS*.

Allocate will only work when consecutive hours are selected.

Analyze

When you have completed a standard analysis pass on the selected time block you can use the Analyze function to signal that your review is complete. The completion is logged in the **allocate_hour** table. This function triggers post-analysis processing on the time block and notifies the lead analyst that the time block is available for quality control.

To signal that the standard analysis pass is complete:

1. Select the hours analyzed in the Hour column by clicking on each hour consecutively with the left mouse button. Hours must be selected consecutively for Analyze to function.

   Selected hours turn green.

2. Click the Analyze button.

   Your name appears in the Analyze column for the selected hours.

Scan

When a scan pass on the selected time block is complete, you can use the Scan button to signal that this milestone is complete. The completion is logged in the **allocate_hour** table. This function triggers post-analysis processing on the time block and notifies the lead analyst that the time block is available for quality control.

To signal that the scan pass is complete:

1. Select the hours scanned in the Hour column by clicking on each hour consecutively with the left mouse button. Hours must be selected consecutively for Scan to function.

   Selected hours turn green.

2. Click the Scan button.

   Your name appears in the Scan column for the selected hours.

Aftershock

The Aftershock function signals that abbreviated analysis has been performed on the selected time period. Abbreviated analysis is performed in response to a large number of aftershock events resulting from a main shock. Assuming a complete analysis was performed on the main event, abbreviated analysis may be performed on all aftershocks to avoid delays in bulletin production.

To signal that the Aftershock pass is complete:

1. Select the hours in which abbreviated aftershock analysis was performed. Click on each hour consecutively with the left mouse button. Hours must be selected consecutively for Aftershock to function.

   Selected hours turn green.

2. Click the Aftershock button.

   Your name appears in the Aftershock column for the selected hours.

ARSscan

ARSscan is the first function in the group of general function buttons. After a time block has been allocated (see "Allocate" on page 318), *ARSscan* is used to create an `ARS.load` file specific to the allocated (selected) time block. *ARS* uses the `ARS.load` file to set its database read parameters. `ARS.load` contains the allocated date, start time and time interval to be analyzed, and an optimized list of stations and channels for the waveform data in that time period. *ARS* displays the channels in this list after it reads the database. `ARS.load` is written in your home directory. If *ARSscan* is not run on the current time block, the `ARS.load` file is not updated, and *ARS* uses an obsolete `ARS.load` file.

To update the `ARS.load` file for *ARS*:

1. Using the left mouse button, select the hours to be analyzed. You must select consecutive hours.

2. Click ARSscan.

   A dialogue box appears. When the *ARSscan* function is finished running, the dialogue box is populated with a description of the updated `ARS.load` file.

3. Click OK to continue.

   The `ARS.load` file is updated.

ARSscan operates on the time block selected in the Hours column of the **allocation** table, not on the hours reserved in the Allocate column. Although selected and allocated hours usually coincide in practice, *ARSscan* can be used to generate an `ARS.load` file for any time period you choose.

Session 1, Session 2, Session 3

These toggle buttons specify the Tuxedo session or agent number for the analysis session launched via the *ARS* button. All applications associated with this analysis session will use this agent number to communicate. This prevents messages and data from conflicting with those from another analysis session. By default, *ARS* is launched with agent 1. You can launch a second *ARS* session by selecting Session 2 in *analyst_log* before starting *ARS*. A second *dman* and *ARS* are launched using agent 2, and all associated applications launched by this second *dman* will communicate using agent 2.

ARS

After you set up your `ARS.load` file using *ARSscan* and verify the correct session number, you can click the graphic ARS button to start *ARS* and an interactive analysis session (Figure 250). This button actually starts the *dman* application using the agent specified by the Session Number button. *dman* then starts *ARS* and begins monitoring messages to start other applications when needed. For step-by-step instructions for starting an *ARS* session see "Software Startup" on page 18.

FIGURE 250.GRAPHIC ARS BUTTON

Run RebQC – Review Event Bulletin Quality Check

At the end of each analyzed time period, you will use *rebqc* to check the database over this time period for possible errors or database conflicts created during the analysis session. These data quality checks include checks for anomalous depths, duplicate arrivals, potential hydroacoustic blockage, arrivals retimed more than 4 seconds, and so forth. Figure 251 provides an example of *rebqc* output.

To run a quality check on the allocated time period:

1. Select the hours to be checked. Click on each hour consecutively with the left mouse button. Hours must be contiguous for *rebqc* to function.

   Each selected hour turns green.

2. Select RebQC.

   A text window with *rebqc* output appears. Typically, you will want to return to your analysis session and make changes based on the findings of *rebqc*.

3. When finished reviewing the *rebqc* output, click OK. The *rebqc* window disappears.

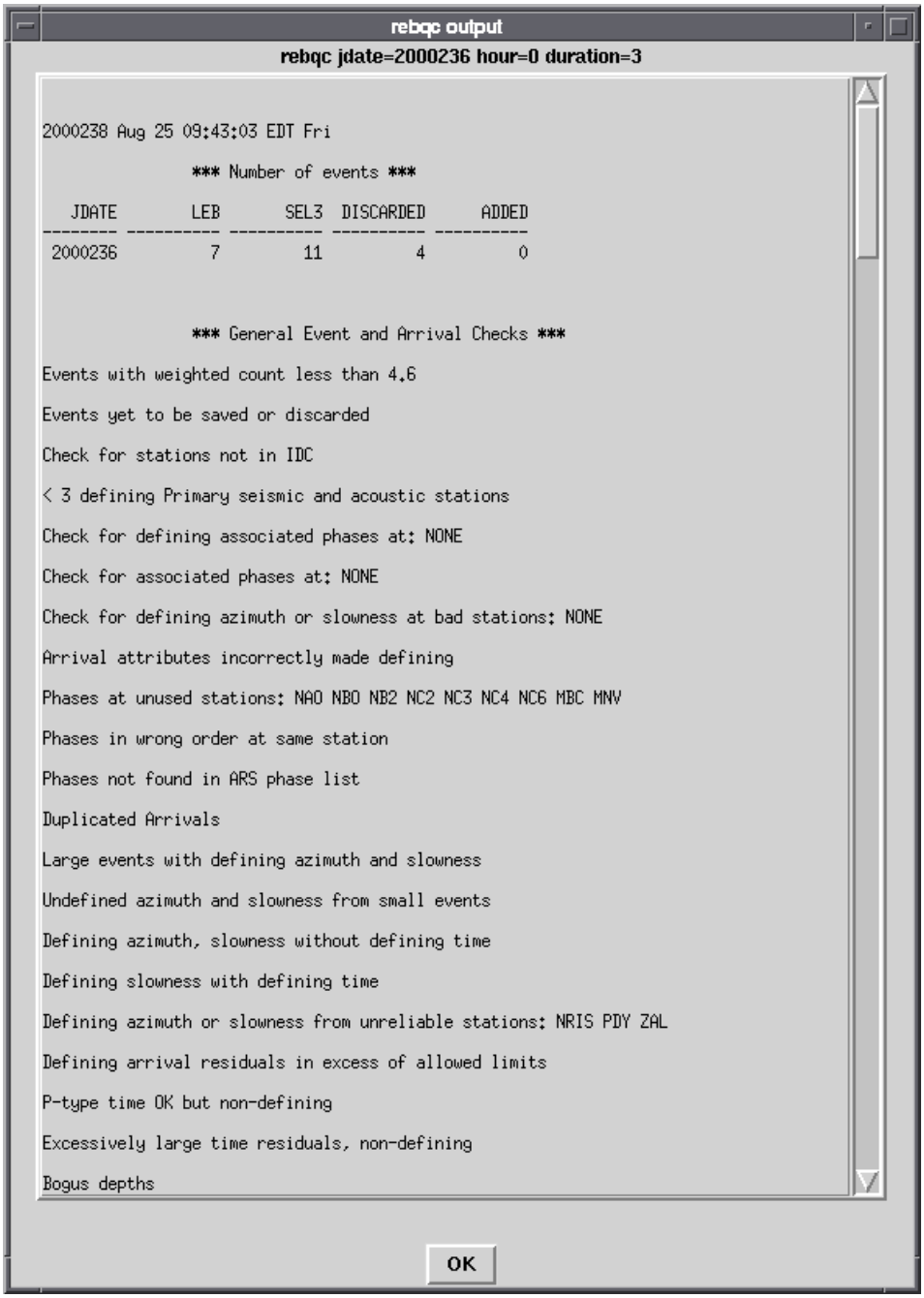

rebqc output
rebqc jdate=2000236 hour=0 duration=3
2000238 Aug 25 09:43:03 EDT Fri
*** Number of events ***
JDATE LEB SEL3 DISCARDED ADDED
2000236 7 11 4 0
*** General Event and Arrival Checks ***
Events with weighted count less than 4.6
Events yet to be saved or discarded
Check for stations not in IDC
< 3 defining Primary seismic and acoustic stations
Check for defining associated phases at: NONE
Check for associated phases at: NONE
Check for defining azimuth or slowness at bad stations: NONE
Arrival attributes incorrectly made defining
Phases at unused stations: NAO NBO NB2 NC2 NC3 NC4 NC6 MBC MNV
Phases in wrong order at same station
Phases not found in ARS phase list
Duplicated Arrivals
Large events with defining azimuth and slowness
Undefined azimuth and slowness from small events
Defining azimuth, slowness without defining time
Defining slowness with defining time
Defining azimuth or slowness from unreliable stations: NRIS PDY ZAL
Defining arrival residuals in excess of allowed limits
P-type time OK but non-defining
Excessively large time residuals, non-defining
Bogus depths
OK

FIGURE 251.REBQC

Show mon_dd

The Show mon_dd function is linked to a script, whose name means "monitor dat-aday." This script lists all events saved to the LEB database account for the selected time block. The LEB is the REB before its final review and publication.

To use the mon_dd function:

1. Select hours for which saved events should be displayed. Click on each hour consecutively with the left mouse button. Hours must be selected consecutively for Show mon_dd to function.

   Each selected hour will turn green.

2. Click Show mon_dd.

   A list of all saved events is displayed in a separate window. This list is not interactive, and changes to events cannot be made via this list.

3. After reviewing the events in this list, click OK to exit the *mon_dd* window.

Message Area

The bottom section of the *analyst_log* Allocation window is a message box. If you attempt an incorrect action, or if an error occurs, a message is displayed here. Figure 252 presents such an error message.

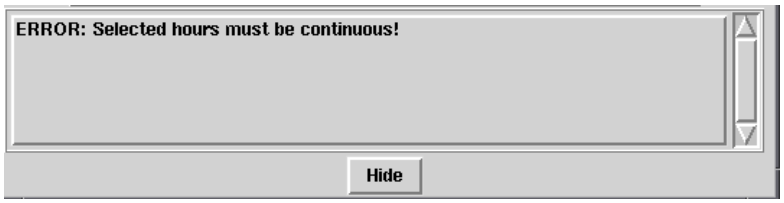


FIGURE 252. MESSAGE OUTPUT FROM ANALYST_LOG

Hide

A Hide button resides at the bottom of the Allocation window. To undisplay the Allocation window, select Hide. The window disappears.

QC

The QC button in the Control window displays the QC window as shown in Figure 253. A QC button is in the Allocation window, which displays the QC window. The functions in the QC window are the group of functions performed just prior to publishing a bulletin.

FIGURE 253.QC WINDOW

The QC window includes a number of status messages. These include the number of events in the dataday, the time of the first event, the time of the last event, completion of the bulletin quality check, and initiation of the bulletin publication process (*rebdone*). These last two messages are bulletin publication milestones which, along with your milestones logged in the allocation table, form a bulletin

analysis history, which is stored in the **allocate_hour** database table. The two buttons at the bottom of the window are used to signal the completion of these milestones.

QC Complete

Click the QC Complete button after reviewing the bulletin for scientific and analytic correctness.

Bulletin Complete

Click the Bulletin Complete button to initiate the *rebdone* procedure (see "Summary of Procedures for Completing a Bulletin" discussed below). After the Bulletin Complete is selected time blocks can no longer be allocated from this dataday.

Hide

A Hide button resides at the bottom of the QC window. To undisplay the QC window, click Hide. The QC window disappears.

Summary of Procedures for Completing a Bulletin

When both the Analyzed and Scan columns have been filled, a check is made of the quality of each saved and rejected event. These checks include visually reviewing events, applying the *rebqc* script, and evaluating the dataday's bulletin. Problem events are corrected and the quality of the bulletin is checked again by applying the *rebqc* script and by visually evaluating the dataday's bulletin. After correcting any problems, the *MsConflict* script is launched to complete the surface wave magnitude computations. After another quality check, any event that still has surface wave conflicts or subsequent magnitude errors are corrected and the QC Complete button is clicked. Clicking the Bulletin Complete button initiates the *rebdone* procedure, which releases or publishes the bulletin.

ADVANCED PROCEDURES

This section provides an introduction to customizing the applications of the Interactive Analysis Subsystem. The Interactive Analysis Subsystem relies heavily on configuration files to tailor its appearance and functionality. These files exist both at the system-wide level in the *$CMS_CONFIG* directory tree and at the user level in each analyst's home directory. The three main file types, which can be customized to suit local needs are: parameter files, X resource files, and Scheme files. Parameter files provide the many repetitive parameters that each application uses during operation. X resource files enhance, or in many cases define, the GUI for each application. Scheme files provide local custom functionality. Chapter 4, "Installation and Configuration Procedures" on page 337 provides details on the types and locations of each application's configuration files. Each application's UNIX man page provides descriptions of command line parameters, which alter the operation of individual applications.

Caution: USE CAUTION WHEN ALTERING ANY CONFIGURATION FILE. THE INTERACTIVE ANALYSIS SUBSYSTEM IS A COMPLEX AND INTERDEPENDENT SYSTEM, WHICH HAS EVOLVED INTO ITS PRESENT ORGANIZATION OVER MANY YEARS OF USE. IMPROPER MODIFICATIONS CAN HAVE ADVERSE AND UNEXPECTED CONSEQUENCES THROUGHOUT THE SYSTEM. ALWAYS MAKE CHANGES JUDICIOUSLY, AND PROVIDE A WAY TO ROLL BACK IF RESULTS ARE NOT WHAT YOU EXPECT.

Changing Look and Feel

The Interactive Analysis Subsystem applications are Motif X window-based applications. When an X application starts, it searches for and interprets a number of resource files to alter its default appearance. X resource files are text files, which contain a list of parameter *name:value* pairs. Changing a named parameter's value in a resource file overrides the parameter's default value. For example, the `.Xdefaults` file provided with the PIDC system contains a line specifying: `ARS*Background: grey85.`

This command tells the *ARS* application to use the color grey85 for its background color. Other parameter values specify the fonts, window sizes, and even the menu contents for the applications. Up to three resource files may contribute to an interactive application's X resources. The `.Xdefaults` file is located in the user's home directory and is the first file searched. The *app-defaults* file is named after the application, for example, *ARS* is located in the directory specified in the user's environment variable *$XUSERFILESEARCHPATH*. For the Interactive Analysis Subsystem this file is maintained by the software developers and provides the minimum resources for a running application. It is generally not modified at a site. The third file is the *app-resources* file. This file is also named after the application and is located in the directory specified in the user's environment variable *$XAPPLRESDIR*. This file generally defines a site's look and feel. Because it is the last file read, the resources it defines take precedence over resource definitions in the other files. For example, the *ARS app-resources* file re-defines all the menus and toolbar buttons giving the IDC *ARS* a much different user interface than the minimal *ARS*.

A complete description of modifying X resources is beyond the scope of this user manual. The series of X window manuals published by O'Reilly & Associates, Inc. is recommended ([Fer93], [Hel94], [Nye92a], and [Nye92b]).

Adding Functionality

A number of the applications *(ARS*, *Map*, and *DFX*) provide a Scheme user interface. The Scheme interface provides an interpreted software layer and an interactive text window that is accessible while the interactive application runs. The interpreted Scheme software provides the "glue" that connects actions in the graphical user interface to the compiled code. The Scheme interface therefore provides a means of adding or customizing site-specific functionality. [IDC7.2.2] provides an introduction to the *ARS* Scheme interface and a listing of all the available Scheme functions.

Another avenue for extending functionality in the Interactive Analysis Subsystem is through the use of scripting languages such as those provided by the *C* or *Bourne* shells or languages like *Perl* or *Tcl*. The ORACLE database provides an *SQL-Plus* scripting language. Several scripts for purging log files or temporary database

tables have been written using scripting languages. The *analyst_log* application provides a user interface, interacts with the database, and is written completely in *Tcl/Tk*. Commercial programming manuals for all of these scripting languages are readily available.

MAINTENANCE

System maintenance generally consists of purging log files and temporary database tables that build-up over time, wasting disk space. On termination, *ARS* purges the temporary database tables it has created after they are two weeks old. As long as regular analysis is underway, no more than two weeks worth of temporary database tables should exist. Other scripts for purging temporary tables may exist. Check with your database administrator.

The Interactive Analyst software is configured to write log files to the same set of directories as the automated and distributed processing systems. These files are purged regularly by scripts belonging to these subsystems.

SECURITY

ARS provides some security to ensure that only analysts have access to the LEB account. Analysts who are allowed access to the operations database must belong to a certain UNIX group, namely group analysts, who are granted access to a file containing operations database passwords. *ARS* automatically accesses this file when a session is started. Without belonging to the proper group *ARS* users will not be allowed access to the operational database passwords. However, you can, with the permission of the administrator of operations database passwords, be granted access to other databases such as the archive database or other research or training database accounts.

Chapter 3: Troubleshooting

This chapter describes how to identify and correct problems related to the Interactive Analysis Subsystem and includes the following topics:

- Monitoring
- Interpreting Error Messages
- Reporting Problems

Troubleshooting

MONITORING

The Interactive Analysis software provides two main methods for monitoring the status of *ARS* and all associated applications. The most powerful monitoring tool is the *dman* status tool. All analysis tools (except *HART*) are represented by icons in *dman*. Each icon is color coded according to the application's operational status (see "dman Procedures" on page 302). Queued messages may also be monitored through *dman*. If you experience a sudden failure of an application, *dman* shows the status of the tool and the number of messages left in the queue. If unprocessed messages are left in the application's queue *dman* provides a convenient method of restarting the application to process the remaining messages. This avoids adding an additional message to process, which happens when relaunching the application from *ARS*.

ARS warnings, which contain both status and error states, are displayed in the message window in *ARS*. All warning messages output from *ARS* are displayed here. Only the most recent message is displayed; *ARS* automatically scrolls as messages are generated. To view previous messages, scroll using the scroll bar to the left of the message window.

INTERPRETING ERROR MESSAGES

Because *ARS* and its associated tools contain over 200 individual functions, it is difficult to describe all the status messages that could result from operator errors, database problems, interprocess communications errors, unexpected system downtime, and software issues. However, a number of the more common messages appearing in the *ARS* message window are explained in this section.

Message: `align-channels: error computing travel time for "TX01/sz" with phase "PKhKP"; aligning on origin time.`

Description: No valid travel times for this phase exist in *ARS*. *ARS* is aligning the waveforms on origin time of the event.

Action: No action is needed. Be aware that data are not aligned on the selected phase as requested.

Message: `DFX experienced an abnormal exit.`

Description: Interactive *DFX* recall processing has failed for one or more specified arrivals.

Action: You can try changing the filters. For hydroacoustic data, try changing the onset/termination times.

Message: `SSSC corrections are not currently supported; using no corrections.`

Description: This informational message states that Source-Station Specific Correction (SSSC) travel time corrections will not be applied to the selected event.

Action: No action is needed.

Message: `Unable to initialize interprocess communications, some functions may be unavailable.`

Description: This message signals that the interprocess communication system, Tuxedo, is not running on the analyst machine.

Action: Ask the processing engineer to restart Tuxedo on the analyst machine.

Message:	`Unable to update origin's location; origin's location is no longer current, please re-locate.`
Description:	*ARS* will not save an event because it does not have a current location.
Action:	Locate the event, using the Locate option in the tool bar, in the AlphaList window, or in the Locator Dialogue Box.

Message:	`<None>`
Description:	The mouse buttons and keyboard no longer are effective in the *ARS* window.
Action:	The Caps Lock on the keyboard may be enabled. Disable the Caps Lock function to return control to the mouse and keyboard.

Error Recovery

Although an *ARS* crash is expected to be a rare event, you should be aware of the methods for recovering a crashed session. The sections "File > Read Recovery Data…" on page 69 and "File > Write Recovery Data" on page 70 discuss how to recover an *ARS* session. If the *ARS* session disappears, meaning there has been a serious application crash, the Read and Write Recovery functions and procedures allow you to recover all of the modifications made to an *ARS* session and to continue working with little or no data loss.

There are no similar methods to recover from crashes by the other interactive applications. However, each application may be quickly restarted through *dman* by selecting the application's icon. Messages that were not processed prior to the crash are processed upon restarting the application.

REPORTING PROBLEMS

The following procedures are recommended for reporting problems with the application software:

1. Diagnose the problem as far as possible.
2. Record information regarding symptoms and conditions at the time of the software failure.
3. Retain copies of relevant sections of application log files.
4. Contact the provider or maintainer of the software for problem resolution if local changes of the environment or configuration are not sufficient.

Chapter 4: Installation and Configuration Procedures

This chapter provides instructions for installing and configuring the software and includes the following topics:

- Preparation
- Third-party Software Packages
- UNIX System and Common Desktop Environment
- Executable Files
- Configuration Data Files
- Database
- Tuxedo Files
- Application-specific Configuration
- Initiating Operations
- Validating Installation

Chapter 4: Installation Procedures

PREPARATION

The Interactive Analysis software is one processing component of a larger S/H/I monitoring system. Successful operation of the applications is dependent on successful installation and operation of the processing components upstream of the applications. Installation of the entire system should follow a carefully coordinated plan including system infrastructure design, installation procedures for each component, and requirements particular to a given release. This section provides installation and configuration details specific to the Interactive Analysis software. These details should be extracted and made part of a general installation plan. The installation team is encouraged to review the release notes, `README` files, and manual pages provided with any particular release.

Obtaining Released Software

The software is obtained via File Transfer Protocol (FTP) from a remote site or via a physical medium such as tape or CD-ROM. The software and associated configuration data files are stored as one or more Tape Archive (tar) files. The software and data files are first transferred via FTP or copied from the physical medium to an appropriate location on a local hard disk. The tar files are then untarred into a standard UNIX directory structure.

Hardware Mapping

You must select the hardware on which to run the software components. Software components are generally mapped to hardware to be roughly consistent with the software configuration model.

THIRD-PARTY SOFTWARE PACKAGES

The Interactive Analysis software is dependent on a number of third-party software packages. Some of these are COTS, and some are public domain (PD), as shown in Table 30. A complete list is provided with each release. Installation procedures for these tools are included in their respective distributions.

TABLE 30: COTS AND PD SOFTWARE FOR INTERACTIVE ANALYSIS SOFTWARE

Package	Type
Sun Solaris	COTS
Java	COTS
Oracle client	COTS
Tuxedo	COTS
perl	PD
Tcl/Tk	PD

UNIX SYSTEM AND COMMON DESKTOP ENVIRONMENT

This section describes the configuration of an analyst's login account by the system administrator for use of the Interactive Analysis software. It is assumed that the analyst's UNIX system administrator has already installed UNIX on the analyst's workstation and has set up an empty login account. These instructions are based on Solaris 7 (Sun Microsystem's version of UNIX) and CDE 1.3.2 (Sun's version of the CDE window manager software). A shell script, *mkCMSuser,* does most of the work of setting up an analyst's environment by copying template files from the configuration directory tree (config tree) installed as part of the software distribution. The script's use is described in "Analyst Environment Installation" on page 342. The procedure for configuring an analyst's account for access to the Interactive Analysis software can be described in two parts: the analyst's shell environment and the analyst's CDE window environment.

C Shell Environment

Each time an analyst logs in or starts a new terminal emulator window such as xterm, the interactive shell references a file in the analyst's home directory named `.cshrc` (C SHell Run Configuration file); the leading dot makes the file invisible in normal listings. Among other things, `.cshrc` defines a number of environment variables, which both the shell and the applications it executes reference. For example, the *$PATH* variable holds a list of directories where the shell looks to find the applications the analyst asks it to run. The `.cshrc` installed by *mkCMSuser* references the file `$CMS_CONFIG/system_specs/env/global.env` to set a number of environment variables critical for use of the Interactive Analysis software. A partial list of these environment variables is shown in Table 31. A number of other environment variables are defined by `global.env`, either for internal use by the applications or for other non-interactive uses.

TABLE 31: ENVIRONMENT VARIABLES USED BY INTERACTIVE ANALYSIS SOFTWARE

Variable Name	Description
HOME	Pathname of analyst's home directory.
CMS_RELEASE	Current IDC software version.
CMS_HOME	Pathname of base of IDC file tree.
CMS_CONFIG	Pathname of base of IDC configuration data tree.
CMS_SCRIPTS	Pathname to executable shell scripts.
ORACLE_HOME	Pathname of ORACLE software product.
ORACLE_SID	Current ORACLE software version.
TUXHOME *TUXDIR*	Pathname of Tuxedo software product.
TUXBASE	Pathname of local Tuxedo configuration files.
QMCONFIG	Pathname of Tuxedo's message queue configuration file.
ULOGPFX *TLOGPFX*	Tuxedo's log files names, excluding extension.

TABLE 31: ENVIRONMENT VARIABLES USED BY INTERACTIVE ANALYSIS SOFTWARE (CONTINUED)

Variable Name	Description
PATH	List of pathnames to applications.
LD_LIBRARY_PATH	List of pathnames to runtime libraries.
XFILESEARCHPATH	List of pathnames to X resource files.
XAPPLRESDIR	List of pathnames to site X resource files.
SCHEMEPATH	Pathname to Scheme files.
JAVA_HOME	Pathname to Java runtime environment.
JLIB_HOME	Pathname to Java runtime libraries.
XGKSFontDir	Pathname to fonts used by *Map*.
Map_DEFAULT_MAP	Default map displayed by *Map*.
MAPDB	*Map*-specific database account.

Common Desktop Environment

The CDE is the top layer of the Interactive Analysis software's GUI. It adds to the X window and Motif graphics libraries a set of interactive window controls similar to those available on most personal computers. The CDE desktop has been customized for use in the Interactive Analysis software by the addition of a toolbar button and menu; these allow the analyst to conveniently start the applications.

The CDE configuration for an individual analyst resides in their home directory in a hidden `~/.dt` subdirectory. The `.dt` subdirectory is the root of a directory tree whose contents are described in "CDE Configuration Notes" on page 345. When an analyst logs into Solaris 7 for the first time, a new `.dt` directory tree is created. This default configuration is fairly empty because most of the configuration comes from system-level defaults. To customize the CDE environment, the *mkCMSuser* script adds icon and action files to the `.dt` tree. The analyst may also customize their CDE environments interactively by using the utilities and instructions accessible through the CDE toolbar.

Analyst Environment Installation

To avoid having to interactively customize each analyst's CDE configuration, two sets of customization files are provided in the config tree. These are located in the `$CMS_CONFIG/system_specs/env/` directories `analysis.dt/` and `process.dt/`. The *mkCMSuser* script is used to install an individual analyst's CDE configuration along with the general login shell environment configuration, (including the `.cshrc` file mentioned above). Running the *mkCMSuser* script copies files from the *analysis.dt* directory tree, customizes some path information, and installs these files in the analyst's `.dt` tree.

To perform the installation:

1. Log in as the analyst.
2. If *mkCMSuser* is run for a new analyst, set the following environment variables:

   ```
   setenv CMS_CONFIG /cmss/config
   setenv CMS_MODE analysis
   setenv PATH /cmss/scripts/bin:$PATH
   rehash
   ```

3. Running *mkCMSuser* without arguments will print out an explanation of its argument list. Typically you should use the following command line:

   ```
   mkCMSuser mode=analysis Xclobber DTclobber=<level>
             saveto=oldconfig.dt
   ```

   where mode specifies an analyst setup, Xclobber specifies installing the general login environment, DTclobber specifies installing the CDE environment and saveto provides a directory name for saving the current CDE environment's .dt tree. The DTclobber level specifies the level of files to replace. If no level is specified, then the script replaces the entire `.dt` directory structure. If level is set to `fponly` (that is, `DTclobber=fponly`), then only files related to the front panel display are removed. Generally, leaving level unspecified for a complete re-installation is recommended.
4. Immediately after running the script, completely exit CDE to the initial login window.

5. After logout, wait 30 seconds for the system hard disk files to update from their memory caches. You can sometimes hear activity on the computer's hard drive when this occurs.
6. Relogin to the windowing system, and verify that the new configuration is in effect.
7. If you are updating an existing analyst and the configuration becomes corrupted, remove the existing `.dt` tree, exit, and relogin.

   This should install a new (empty) `.dt` tree upon which *mkCMSuser* can make a cleaner installation.

Use the CDE Style Manager:Window tool to verify that the following two options "Raise Window when Made Active" and "Allow Primary Window On Top" are both off (unchecked). In a Solaris 7 default environment these are on. They can cause an application to appear frozen if a primary window raises above a blocking popup window. You cannot see or access the popup, but the primary window does not respond. The correct settings are shown in Figure 254. Also, access the Style Manager:Startup tool and make sure the At Login: Return to Home session is set. By default the Resume current session is set which restarts any applications running when the CDE session is exited. This may unexpectedly start unwanted applications. The correct settings are shown in Figure 255.

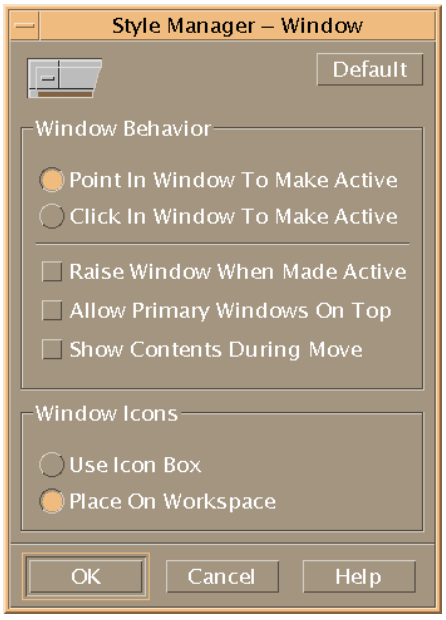


FIGURE 254. TYPICAL STYLE MANAGER – WINDOW SETTINGS

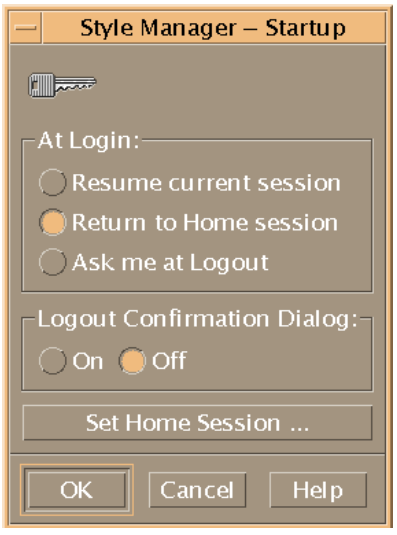


FIGURE 255. TYPICAL STYLE MANAGER – STARTUP SETTINGS

CDE Configuration Notes

The Help menus on the CDE toolbar provide instructions for the interactive CDE customization utilities. However, the file configuration structure contained in the `.dt` directory tree is poorly documented. This section summarizes this structure and provides documentation not available elsewhere.

When a new analyst logs into the CDE windowing system, a default `~/.dt` directory structure is created for them. Performing a directory listing, `ls` in this directory then yields:

```
C/ appmanager/ help/ sessionlogs/ tmp/ Desktop/
errorlog icons/ sessions/ types/ Trash/
errorlog.old palettes/ startlog wsmenu/
```

Of these, `appmanager/`, `help/`, `tmp/`, `Desktop/`, `icons/`, `Trash/`, and `palettes/` are empty. The directory `types/` only contains two empty subdirectories: `fp_dynamic/` and `fp_dynamic1/` (one directory for each display on a dual-headed workstation). The directory `wsmenu` contains a subdirectory for each menu on the CDE toolbar. By default these subdirectories are:

```
Applications/ Files/ Help/ Links/ Tools/ Cards/
Folders/ Hosts/ Mail/
```

These directories contain the executable dummy files for each of the icon buttons in the pull-up menus. The term "dummy file" is used because executing the file from the command line only displays the message:

```
Common Desktop Environment (CDE) action. Invoke using the
File Manager.
```

The files act as dummy place holders named for each menu's actions. The term "action" is used in the CDE documentation to refer collectively to the set of files that generate the functionality seen when clicking the CDE icon buttons. These notes follow that convention.

The `C/` directory contains startup scripts for the window manager. While modifying these scripts offers an alternative method of customization, they have not been used for the customization described here. Instead, the customization method

used was to manually create files similar to those produced as a result of using the CDE customization utilities provided through the CDE toolbar. If you were to use the CDE customization utilities to create an action, the following files would be created:

1. In `~/.dt/types/fp_dynamic` an <*action*>`.fp` file is created. This file defines a control for the front panel. A control in this case is an icon button. The file defines a name for the control (for example, *ARS*), its location, its icon file base name, and the name of a dummy file. All these names are generally the same (for example, *ARS*), and the `.fp` file would be named *ARS1.fp*. See the *dtfpfile(4)* man page for complete file format instructions. The *ARS1.fp* file looks like:

```
CONTROL ARS
{
TYPE                    file
CONTAINER_TYPE          SUBPANEL
CONTAINER_NAME          PersAppsSubpanel
POSITION_HINTS          last
ICON                    ARS
FILE_NAME               $(HOME)/.dt/menu_items/ARS
}
```

   The `FILE_NAME` entry specifies the full path to the dummy file. *mkCMSuser* adds the directory *menu_items* to the analyst's `.dt` tree and installs all dummy files there. `$(HOME)` is replaced with the analyst's home directory path when installed by *mkCMSuser*.

2. A set of icon files is added to the `.dt/icons` directory. All files will have the same base name (for example, *ARS*). The two that are actually used are `ARS.m.pm` and `ARS.l.pm` for the medium and large sizes. The medium size is used in the pull-up menus, and the large size is used if the button is promoted to the front panel.

3. A dummy file is placed by default in the analyst's home directory. These dummy files have been collected and placed in the `.dt/menu_items` directory. The dummy files provide an action name, the filename, with which to search the dt action database.
4. In `.dt/types` an <*action*>`.dt` file is created. This file defines the action to be performed. The action is a recognizable UNIX command. The file also defines the type of window the command should run in. For GUIs or shell scripts, as in this example, no window is necessary. The data in this file is entered into the dt action database under a specified label, which must match the name of the dummy file. When the control is activated, the action database is searched for the label and the corresponding action is performed. The *dtdtfile(4)* man page describes the file's format. The `ARS.dt` file looks like:

```
ACTION ARS
{
LABEL                   ARS
TYPE                    COMMAND
EXEC_STRING             start program=ARS
ICON                    ARS
WINDOW_TYPE             NO_STDIO
}
```

The *EXEC_STRING* specifies the UNIX command to execute. In this case it runs the `$CMS_SCRIPTS/bin/start` script with the argument *program=ARS*. The analyst's `$PATH` environment variable is referenced to find the *start* script.

To summarize, the general method to add an action button to a CDE pull-up menu is to:

- add a `.fp` file to `.dt/type/fp_dynamic/` to define the action button's appearance in the tool bar
- add a `.dt` file to `.dt/types/` to define the button's actions
- add an icon set to `.dt/icons/`
- add a dummy file to `.dt/menu_items/`

Using the CDE utilities is convenient for individual use, but is very time consuming for a system administrator attempting to configure a number of analyst's login accounts. To expedite configuration and ensure standardization, the *mkCMSuser* script installs these files from the config tree creating all the new actions in one operation.

The Applications menu icon button has been replaced with the *analyst_log* icon button on the CDE front-panel to make it the most accessable. To accomplish this, an additional file has been added by the *mkCMSuser* script to `~/.dt/types/fp_dynamic/`. This file is called `Applicat1.fp` and looks like:

```
CONTROL Applications
{
TYPE                    icon
CONTAINER_TYPE          SUBPANEL
CONTAINER_NAME          PersAppsSubpanel
DELETE                  True
}
```

This control file provides an override to the system default specifying that the Applications icon on the PersAppsSubpanel should be deleted. It will be replaced by the `AnalystLog.l.pm` icon.

A pull-up menu's icon can be promoted to the front panel manually by clicking on the menu icon with the right mouse button and selecting Promote to Front Panel. Be sure to save the analyst's session after doing this so the changes become permanent.

The term session refers to all the windows and applications running in the analysts' CDE environment when they log into their workstations. A session file is saved in the `.dt/sessions/` directory. A default session is provided in the `analyst.dt/sessions` config directory in the config tree, which provides several terminal emulator windows at CDE startup. Saving a session replaces this file with one that specifies all applications running at the time the session is saved. Therefore, a session should be saved with only those running applications that should be automatically started at each CDE login. The home session is saved using the Style Manager:Startup window options.

The `.dt/sessions/` directory also contains a `home/` subdirectory, which contains three files `dt.resources`, `dt.session`, and `dt.settings`. Reasonable defaults for these are installed by *mkCMSuser* from the `analyst.dt/` directory in the config tree. The `dt.resources` file specifies a number of X resources for the CDE window including its color layout. The default color layout is *Desert.dp,* and its specification file is installed in the `.dt/palettes` directory. The `dt.session` file specifies a default session, and the *dt.settings* file specifies some startup and shutdown options. These options should override the Style Manager-Window and Startup defaults noted above, but this should be verified.

EXECUTABLE FILES

This section provides background on the location and composition of the executable files that make up the Interactive Analysis software. Executable application files are generally located in the directory `$CMS_HOME/bin` with executable shell scripts located in `$CMS_SCRIPTS/bin`. The *$PATH* environment variable, as defined in an analyst's `.cshrc` file, includes these directories. When executed, many of the applications are assembled from multiple files. In addition to the compiled code located in the `bin` directory, the loader will link dynamic code libraries such as the *C* or *Motif* runtime libraries. The *ldd* command can be used to list the paths to all the dynamic libraries required by an application. For example, executing *ldd* on the PIDC 7.0 *ARS* application yields the following list:

```
libF77.so.4 =>      /opt/SUNWspro/lib/libF77.so.4
libM77.so.2 =>      /opt/SUNWspro/lib/libM77.so.2
libXm.so.4 =>       /usr/dt/lib/libXm.so.4
libXmu.so.4 =>      /usr/openwin/lib/libXmu.so.4
libXt.so.4 =>       /usr/openwin/lib/libXt.so.4
libXext.so.0 =>     /usr/openwin/lib/libXext.so.0
libX11.so.4 =>      /usr/openwin/lib/libX11.so.4
libtux.so.60 =>     /home/tuxedo/6.5/lib/libtux.so.60
libbuft.so.60 =>    /home/tuxedo/6.5/lib/libbuft.so.60
libtux2.so.60 =>    /home/tuxedo/6.5/lib/libtux2.so.60
libfml.so.60 =>     /home/tuxedo/6.5/lib/libfml.so.60
libfml32.so.60 =>   /home/tuxedo/6.5/lib/libfml32.so.60
```

```
libgp.so.60 =>      /home/tuxedo/6.5/lib/libgp.so.60
libgen.so.1 =>      /usr/lib/libgen.so.1
libsocket.so.1 =>   /usr/lib/libsocket.so.1
libnsl.so.1 =>      /usr/lib/libnsl.so.1
libelf.so.1 =>      /usr/lib/libelf.so.1
libm.so.1 =>        /opt/SUNWspro/lib/libm.so.1
libdl.so.1 =>       /usr/lib/libdl.so.1
libsunmath.so.1 => /opt/SUNWspro/lib/libsunmath.so.1
libc.so.1 =>        /usr/lib/libc.so.1
libSM.so.6 =>       /usr/openwin/lib/libSM.so.6
libICE.so.6 =>      /usr/openwin/lib/libICE.so.6
libmp.so.2 =>       /usr/lib/libmp.so.2
```

If an application fails to load because of a missing dynamic library, you can use the *ldd* command to show where the loader expects to find it.

The applications may also look for X window resource files that define or customize their GUI. The X defaults resource file location is specified by the *$XFILESEARCHPATH* environment variable, and for the Interactive Analysis software it includes the path `$CMS_HOME/X11/app-defaults`. The X customization resource file is specified by the *$XAPPLRESDIR* environment variable and for the Interactive Analysis software it includes the path `$CMS_CONFIG/system_specs/app-resources`. The X resource files located in these directories have the same name as the application. At run time, the X defaults resource is loaded first and the X customization resource file is loaded second and can override definitions made in the first file. In the Interactive Analysis software, this file is used for site-specific customization.

Several of the applications include interpreted Scheme code and require Scheme libraries located in the path specified by the *$SCHEMEPATH* environment variable, which includes the `$CMS_HOME/scheme` directory. The *ARS* application also requires a `.ARSinit` file located in the analyst's home directory. A detailed and *ARS*-oriented description of configuring Scheme is provided in [IDC7.2.2].

Several of the applications are implemented in Java. Because Java applications must run in a Java runtime environment (JRE), the "executable" file for these applications, (for example, `$CMS_HOME/bin/HART`) is actually an executable shell script that runs the JRE with the correct Java code. The path for the JRE is specified in the environment variable *$JAVA_HOME,* and the path to the Java code files is specified in the environment variable *$JLIB_HOME*. Java applications do not use Scheme or X resources.

CONFIGURATION DATA FILES

The Interactive Analysis software is dependent on configuration parameters contained in hundreds of configuration data files. These files are maintained in a configuration directory tree (config tree) and are shared with other subsystems in the greater S/H/I analysis system. The base of the config tree is specified by the *$CMS_CONFIG* environment variable and is usually set to `$CMS_HOME/config`. The structure of the config tree is described in [Koh98b], and instructions for configuring and customizing the files in this tree are provided in [IDC6.2.4]. A section of [IDC6.2.4] is specific to the Interactive Analysis software.

Those applications that use files in the config tree are started with a parameter (par) file specified on their command line. These par files, or the par files they reference, specify the paths and filenames for the configuration data files referenced. The *dman* application starts most applications, and its par file specifies the execution command lines (and therefore the par file path names) for these applications. The *dman* application is described in more detail on page 364.

DATABASE

The Interactive Analysis software provides a major analysis step in the flow of seismic, hydroacoustic, and infrasonic data through the various IDC database accounts. In general, the applications read and write data to the LEB account; however, table synonyms often redirect input from other accounts. Figure 256 shows the actual analysis database accounts accessed via synonyms. These redirections include the waveform and detection data in the IDCX account, the station

information from the STATIC account, and the arrival, association, and origin information from the SEL3 account as input. Waveform data are obtained from the UNIX file system. The *Map* application additionally accesses a *Map* account for map-related information. All analyst results are written to the LEB account.

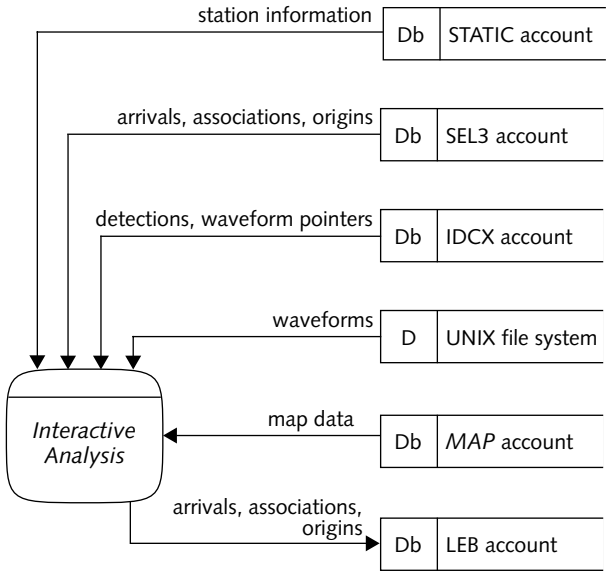


FIGURE 256. INTERACTIVE ANALYSIS DATABASE ACCESS

A detailed description of the configuration of the PIDC database is given in [IDC5.1.3Rev0.1]. The database schema are described in [IDC5.1.1Rev2].

Within the Interactive Analysis software, interprocess communication makes use of temporary database tables written in the LEB account. The *ARS* application deletes the temporary tables it creates on exit. It also deletes temporary tables more than a week old to remove temporary tables orphaned by abnormal application exits.

TUXEDO FILES

Tuxedo is a COTS application framework for distributed application control used to manage the automatic pipeline processing of IDC data. A lighter weight configuration of this framework is used on each analyst workstation to facilitate communication between applications. The distributed application control system (DACS) is documented in [IDC6.5.2Rev0.1] and contains a chapter dedicated to interactive processing. A high-level overview of Tuxedo and DACS is presented here to provide a context for interprocess communication (IPC) within the Interactive Analysis software.

The primary task of Tuxedo in the interactive environment on an analyst workstation is to maintain a set of message queues for the posting of messages between applications. Currently queues are configured for thirteen applications. Because each workstation can support three concurrent analysis sessions, there are 39 queues, one for each session/application.

Queue Configuration

Queues are configured by the script `$CMS_SCRIPTS/bin/crInteractive`, which is both a configuration file defining the queues and an installation shell script that builds and installs the workstation's runtime configuration file. During installation, *crInteractive* translates the `$(TUXDIR)/config/scripts/templates/ubb.analysis.templ` into each workstation's human readable `/var/tuxedo/<rel>_analysis/config/ubb` and binary `/var/tuxedo/<rel>_analysis/config/tuxconfig` configuration files. To add or remove a queue, the administrator must modify both *crInteractive* and `ubb.analysis_template`. Refer to [IDC6.5.2Rev0.1] for specific installation and configuration instructions.

When an analyst's workstation boots, a script installed in the workstation's `/local/lib/rc` directory automatically runs `$(TUXDIR)/bin/tmboot`, which starts the Tuxedo IPC system in accordance with the *tuxconfig* file. If this script is not installed, then *tmboot* must be run manually by the system administrator. *tmboot* starts a number of Tuxedo-provided daemon applications (*BBL, TMS/TMS_QM, TMQUEUE, TMSYSEVT,* and *TMUSREVT)*, which manage interac-

tion with the message queues and are always running on the workstation. Applications such as *ARS* use calls to *libipc* to register with Tuxedo and interact with these daemons to post and retrieve messages from the queues.

For each of the *DFX* applications used for interactive recall processing and beaming, *tmboot* starts a pair of daemons, the Tuxedo-provided *TMQFORWARD,* and the IDC `$CMS_HOME/bin/tuxshell`. *TMQFORWARD* monitors a *DFX* queue for activity, dequeues new messages, and forwards them to its partnered *tuxshell*. *Tuxshell* uses the message to build an appropriate command line for *DFX*. It then executes *DFX* and monitors *DFX*'s return status, which it posts in a return message to the sender of the original message. Each *tuxshell* uses the configuration data in *tuxshell-<queuename>.par* to configure the command line for *DFX* for its specific application, *recall seismo*, *recall hydro*, or *beamer* (beam on the fly). The path to each *tuxshell*'s par file, `$CMS_CONFIG/app_config/distributed/tuxshell/interactive`, is provided by *tmboot* from *tuxconfig*.

Log Files

Tuxedo writes a number of log files which can be useful for diagnostic purposes. The Tuxedo-provided daemons write system logs in the directories `/var/tuxedo/<rel>_analysis/ULOGS/ULOG<jday>`. A *crontab* entry is normally installed; it purges *ULOG* files after ten days. *Tusxhell* writes its logs in the files `$(LOGDIR)/`*<jdate>*`/interactive/tuxshell-`*<role>*`-`*<host machine>*`-`*<pid>* where *role* is `Beamer`, `DFXRecall`, or `DFXHydroRecall`. The matching *DFX* log file is written in the same directory with a similar filename. See "Detection and Feature Extraction (DFX)" on page 362.

Tuxedo Events and dman

The *dman* application is discussed specifically on page 364; however, several features of Tuxedo are used by *dman* to monitor message traffic and track interactive application run status. In addition to messages, Tuxedo provides the ability to send events to client applications. *dman* subscribes to Tuxedo events, which get sent whenever a client application registers or de-registers with Tuxedo. *libipc* takes advantage of this event capability by requesting an event be sent to *dman* when-

ever an interactive application posts or reads a message. This feature enables *dman* to monitor message traffic and update the displayed queue sizes for each of its client applications. Finally *dman*, via *libipc*, can make queries to Tuxedo for message queue size or message queue purging.

APPLICATION-SPECIFIC CONFIGURATION

ARS

Analyst Review Station (*ARS*) can be considered the centerpiece of the Interactive Analysis software because the analysts spend more time working in *ARS* than any other application. *ARS* is also the most highly customizable of all the applications. The analyst's view of *ARS* is abstracted in Figure 257. The analyst interacts with the GUI, which calls Scheme functions, which call C functions, which interact with the data. At both the GUI and Scheme levels, configuration files affect the analyst's view of *ARS*. The *ARS* GUI is configured by the following three X resource files:

```
$CMS_HOME/X11/app-defaults/ARS
$CMS_CONFIG/system_specs/app-resources/ARS
~/.Xdefaults
```

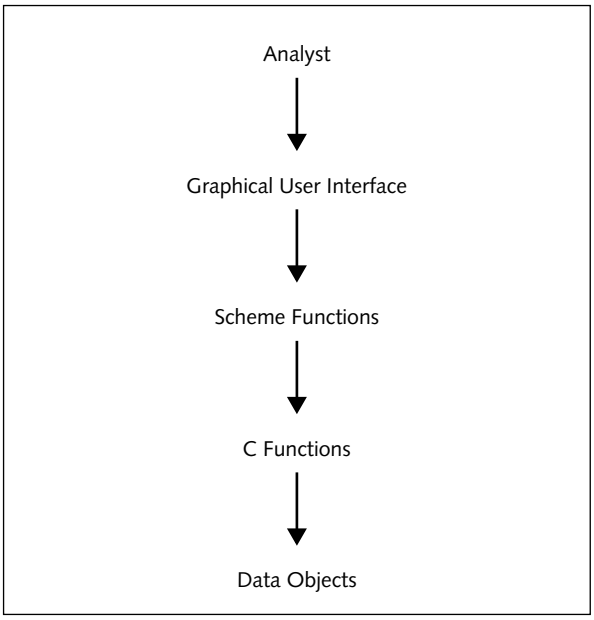


FIGURE 257. ANALYST VIEW OF ARS

The .../app-defaults/ARS X resource file provides the default layouts for the *ARS* menus and toolbar buttons and assigns the Scheme functions that are called when the analyst activates them. It also defines the layout of much of the rest of *ARS*'s graphical interface including AlphaList column titles and widths. This file provides the minimum X resources to allow *ARS* to run. It should not be modified.

The .../app-resources/ARS file provides site-specific X resource customization. In the case of the IDC, this file almost completely redefines the *ARS* menus, toolbar layout, and Scheme function assignments. The *mkCMSuser* script installs a default `.Xdefaults` file in the analyst's home directory. This X resource file specifies colors, fonts, and locations for many of the *ARS* windows. Together, these two files customize the appearance of the IDC *ARS*.

The *ARS* Scheme configuration is defined by the following files:

```
$CMS_HOME/scheme/intrinsic.scm
$CMS_HOME/scheme/siod.scm
$CMS_HOME/scheme/general.scm
$CMS_HOME/scheme/math.scm
$CMS_HOME/scheme/libpar.scm

$CMS_HOME/scheme/ARSdefault.scm

~/.ARSinit
$CMS_CONFIG/app_config/interactive/ARS/IDC.scm
~/ARS.load
```

The first group of files provide the fundamental Scheme functionality common to all the IDC applications that use Scheme. The `ARSdefault.scm` file provides *ARS* with the bulk of its Scheme functionality. This file is maintained by *ARS* developers and should not be modified.

The *mkCMSuser* script installs a default `.ARSinit` file in the analyst's home directory. After loading `ARSdefault.scm`, *ARS* loads `.ARSinit` if it can find it in the analyst's home directory. As installed, `.ARSinit` loads `IDC.scm`, which provides IDC custom Scheme functionality. This file redefines functions in `ARSdefault.scm` and adds new functions. Many of the menu assignments customized by `…/app-resources/ARS` are made to Scheme functions in `IDC.scm`. The `.ARSinit` file also directs loading of the `ARS.load` file from the analyst's home directory. This file specifies the database, time window, network, and initial channel display list for the *ARS* session. The file is created for each session by the *analyst_log* script through a call to the *ARSscan* script.

When *ARS* is run, its UNIX command line must specify a parameter or par file. The *dman* application, which starts *ARS*, is configured to specify `$CMS_CONFIG/app_config/interactive/ARS/ARS.par`. This par file specifies the paths to the many configuration data files, such as travel time tables and station correction tables, which *ARS* depends on for its computations. The file contains a number of other parameter definitions as well. `ARS.par` references `$CMS_CONFIG/system_specs/shared.par` to obtain system-level global parameter values.

ARS writes a crash recovery file, which is a binary copy of its internal data structures to the file specified by the environment variable *$ARS_RECOVERY_FILE*. The `.cshrc` file installed in the analyst's home directory by *mkCMSuser* sets this variable to `/tmp/$user.recovery`. If the variable is not set, then by default this file goes in the analyst's home directory. If *ARS* crashes, it writes a log file named `ARS.history` to the analyst's home directory. This file contains a history of the Scheme functions *ARS* executed up to the crash.

XfkDisplay

The *XfkDisplay* application is primarily written in C and makes only limited use of Scheme for interpreting IPC messages. Its menus and toolbar buttons are tied directly to C functions; therefore, it is much less customizable than *ARS*. *XfkDisplay* uses a public domain widget creation library (WCL), which allows definition of much of its GUI in X resource files. The default X resource file, `$CMS_HOME/X11/app-defaults/XfkDisplay`, is extensive. This file uses WCL syntax and is required for operation. An IDC site-specific X resource customization file, `$CMS_CONFIG/system_specs/app-resources/XfkDisplay`, has been maintained by *XfkDisplay* developers.

Configuration of *XfkDisplay* is primarily through the parameters set in its par file and the configuration data files that are referenced. *XfkDisplay* provides an extensive set of configuration and tuning parameters. These are described in the *XfkDisplay* man page, *XfkDisplay(1)*. The *dman* application specifies the par file `$CMS_CONFIG/app_config/interactive/XfkDisplay/XfkDisplay.par` when it starts *XfkDisplay*. This file in turn references the following par files:

```
$CMS_CONFIG/app_config/interactive/XfkDisplay/XfkDisplay.par
$CMS_CONFIG/system_specs/process.par
$CMS_CONFIG/system_specs/shared.par
$CMS_CONFIG/system_specs/interactive.par
$CMS_CONFIG/app_config/interactive/XfkDisplay/arrays/*.par
$CMS_CONFIG/app_config/interactive/XfkDisplay/recipes/*.par
$CMS_CONFIG/earth_specs/TT/vmsf/ims.defs
```

XfkDisplay does not write a log file but writes error messages to a shell window.

Map

The *Map* application uses an architecture similar to *ARS* and provides for customization using X resources and Scheme. The default *Map* menu assignments are defined in `$CMS_HOME/X11/app-defaults/Map` with IDC customization defined in `$CMS_CONFIG/system_specs/app-resources/Map`. The *Map* Scheme configuration is defined by the following files:

```
$CMS_HOME/scheme/intrinsic.scm
$CMS_HOME/scheme/siod.scm
$CMS_HOME/scheme/general.scm
$CMS_HOME/scheme/libpar.scm
$CMS_HOME/scheme/math.scm

$CMS_HOME/scheme/Mapdefault.scm
$CMS_HOME/scheme/Mapgc.scm

~/.Mapinit
$CMS_CONFIG/app_config/interactive/Map/Mapconfig.scm
$CMS_CONFIG/app_config/interactive/Map/overlay.scm
$CMS_CONFIG/app_config/interactive/Map/IDC_MAP.scm
$CMS_CONFIG/app_config/interactive/Map/Map_Analyst_Tools.scm
```

The first group of files provides the fundamental Scheme functionality common to all the IDC applications that use Scheme. The `Mapdefault.scm` file provides *Map* with the bulk of its Scheme functionality. The `Mapgc.scm` file defines graphic contexts for *Map*. These files are maintained by *Map* developers and should not be modified.

The IDC implementation does not use a `Mapsite.scm` file, but this file is searched for in the `$CMS_HOME/scheme` directory and would be loaded after `Mapgc.scm` if found. Next, *Map* searches for a `.Mapinit` file in the analyst's home directory and loads this file. The *mkCMSuser* script installs a default `.Mapinit` file, which loads `Mapconfig.scm`, `overlay.scm`, `IDC_MAP.scm`, and `Map_Analyst_Tools.scm`. These files provide IDC custom functionality.

The *Map* application uses fonts from the directory `$CMS_HOME/X11/Map_xgksfonts` as specified by the environment variable *$XGKSFontDir*. *Map* also accesses its own database account as specified in the environment variable *$Map_DATABASE* and described in [IDC5.1.3Rev0.1] and [IDC5.1.1Rev2].

Map does not write a log file, but writes error messages to its Scheme window.

AEQ

The *AEQ* application references a default X resource file in `$CMS_HOME/X11/app-defaults/AEQ`. It does not have an IDC customization file. Configuration of *AEQ* is primarily through the parameters set in its par file and the rules files that are referenced. *AEQ* provides an extensive set of configuration parameters, which are described in the *AEQ* man page, *AEQ(1)*. The *dman* application specifies the par file `$CMS_CONFIG/app_config/interactive/AEQ/AEQ.par` when it starts *AEQ*. This file in turn references the following par files:

```
$CMS_CONFIG/system_specs/process.par
$CMS_CONFIG/system_specs/interactive.par
```

AEQ uses a public domain rules interpretation library (*CLIPS*) to perform its event analysis. The `AEQ.par` file specifies the *CLIPS* rules file `$CMS_CONFIG/app_config/interactive/AEQ/AEQ.clp`.

AEQ does not write a log file although a results file can be specified in the `AEQ.par` file. Presently *AEQ* writes its results to its display window.

IADR

The *IADR* application is implemented in Java; therefore, its execution requires that a Java Runtime Environment (JRE) be specified in the environment variable *$JAVA_HOME*. The `$CMS_HOME/bin/IADR` shell script launches the JRE and specifies the Java code files. The following Java archives and shared objects compose *IADR*:

`$CMS_HOME/jlib/IADR.jar`	(Java code archive)
`$CMS_HOME/jlib/libjipc.so`	(JNI shared library)
`$CMS_HOME/jlib/ipc.jar`	(IPC code arcive)
`$CMS_HOME/jlib/util.jar`	(utilities archive)

The *dman* application specifies the par file `$CMS_CONFIG/app_config/interactive/IADR/IADR.par` when it starts *IADR*. This file in turn references the par file `$CMS_CONFIG/system_specs/process.par`. The *IADR* application accesses the database tables IDCX:**request** and IDCX:**msgdisc** in addition to the standard interactive database usage.

HART

The *HART* application is implemented in Java; therefore its execution requires that a Java Runtime Environment (JRE) be specified in the environment variable *$JAVA_HOME*. The `$CMS_HOME/bin/HART` shell script launches the JRE and specifies the Java code files. The following Java archives and shared objects compose *HART*:

`$CMS_HOME/jlib/HART.jar`	(Java code archive)
`$CMS_HOME/jlib/libHART_compute.so`	(JNI shared library)
`$CMS_HOME/jlib/util.jar`	(utilities archive)

HART is not monitored by *dman*. Instead it is started by the `$CMS_SCRIPTS/bin/start_hart_server` script, which is started by the `$CMS_SCRIPTS/bin/start` script, which is started from the *HART* CDE menu item. The *start_hart_server* script is also run each time *dman* is started by *analyst_log* to verify that *HART* is running. The *ARS* and *HART* applications communicate via sockets and must use the same port number to initiate communications. The *start_hart_server* script specifies this port number for *HART,* and the `ARS.par` file (see the *ARS* section above) specifies it for *ARS*. The *HART* man page contains more information on specifying port number.

The *HART* application normally never terminates even when the analyst logs out. It must be stopped using the UNIX *kill* command in a shell window. When the *start_hart_server* script launches *HART,* it specifies the par file `$CMS_CONFIG/`

app_config/interactive/HART/HART.par. The start_hart_server script redirects *HART*'s output to the log file $(LOGDIR)/HART/<*machine*>_hart.log, where *machine* is the host machine running *HART*.

PolariPlot

PolariPlot uses a public domain widget creation library (WCL), which allows definition of much of its GUI in X resource files. The default X resource file, $CMS_HOME/X11/app-defaults/PolariPlot, is extensive. This file uses WCL syntax and is required for operation. There is no IDC site-specific X resource customization file. *PolariPlot* does not use a parameter file or Scheme and does not write a log file.

SpectraPlot

SpectraPlot uses a public domain WCL, which allows definition of much of its GUI in X resource files. The default X resource file, $CMS_HOME/X11/app-defaults/SpectraPlot, is extensive and uses WCL syntax. The IDC site-specific X resource customization file, $CMS_CONFIG/system_specs/app-resources/SpectraPlot, generally duplicates the …/app-defaults/SpectraPlot file with some deletions. One of these files is required for operation. *SpectraPlot* does not use a parameter file or Scheme and does not write a log file.

Detection and Feature Extraction (DFX)

The *DFX* application provides a general purpose signal processing environment. *DFX* uses par files and Scheme code to configure specific behavior. The Interactive Analysis software uses *DFX* in three configurations to

- beam phases,
- calculate waveform attributes for seismic arrivals, and
- calculate waveform attributes for hydroacoustic arrivals.

DFX is launched as a background task in response to messages composed and sent from *ARS*. Depending on the task to be performed, *ARS* sends a message to one of three message queues, *BOTF*, *RSEISMO*, or *RHYDRO*.

As described in "Tuxedo Files" on page 353, each queue has an associated *tuxshell* daemon, which receives the message, parses it into a command line for *DFX*, and launches *DFX*. Each queue's *tuxshell* is configured to include an appropriate par file reference on the *DFX* command line. When *DFX* completes, *tuxshell* captures its exit status and returns a message to *ARS* with that exit status. Processing details and error conditions are written to the *tuxshell* and *DFX* log files shown below. *ARS* and *DFX* use temporary database tables to exchange data, and the *ARS* message contains references to these tables.

The *tuxshell* for each queue is configured with one of the following par files in the `$CMS_CONFIG/app_config/distributed/tuxshell/interactive/` directory:

```
tuxshell-BOTF.par
tuxshell-RSEISMO.par
tuxshell-RHYDRO.par
```

These par files in turn specify the appropriate *DFX* par file:

```
$CMS_CONFIG/app_config/DFX/DFX-botf.par
$CMS_CONFIG/app_config/DFX/DFX-recall.par
$CMS_CONFIG/app_config/DFX/DFX-hydro-recall.par
```

The following Scheme files appropriate for each *DFX* task are specified by the *DFX* par file:

```
$CMS_CONFIG/app_config/DFX/scheme/DFX-botf.scm
$CMS_CONFIG/app_config/DFX/scheme/DFX-recall.scm
$CMS_CONFIG/app_config/DFX/scheme/DFX-hydro-recall.scm
```

The *tuxshell* daemons for *DFX* write their log files to

```
$(LOGDIR)/%jdate/interactive/tuxshell-<role>-<host>-<pid>
```

and the *DFX* applications write their log files to:

`$(LOGDIR)/%jdate/interactive/`<*role*>`-`<*host*>`-`<*pid*>

where *role* is `Beamer`, `DFXRecall`, or `DFXHydroRecall`, *host* is the host machine, and *pid* is tuxshell's UNIX process identifier (ID).

See [IDC7.1.1] for general information on configuring and programming *DFX*.

dman

The *dman* application is the demand execution manager for the Interactive Analysis software. In conjunction with the Tuxedo-based interprocess communication (IPC) libraries, *dman* monitors message traffic between applications and starts recipient applications as necessary to ensure they receive and respond to incoming messages. The Tuxedo IPC system must be running for *dman* to operate.

dman is started by the `$CMS_SCRIPTS/bin/start` script either from the CDE menu or from the *analyst_log* application. The *start* script specifies the par file `$CMS_CONFIG/app_config/distributed/dman/dman.par` when launching *dman*. This par file in turn references the file:

`$CMS_CONFIG/system_specs/process.par`

dman uses its par file to specify the list of client applications that it will monitor, their complete command line argument lists, and numerous other configuration and operation parameters. An example par file and description of parameters are given in the *dman* man page *dman(1)*.

dman writes its log file to `$(LOGDIR)/`<*jdate*>`/interactive/dman-`<*machine*>`-`<*user*>`-`<*agent*>, where *jdate* is the julian date, *machine* is the host machine, *user* is the user identifier, and *agent* is the Tuxedo session specifier. *dman* finds the application icons for its user interface in the directory `$CMS_CONFIG/system_specs/env/process.dt/icons`. These pathnames are specified in its par file. *dman* does not use X resources or access the database.

analyst_log

The *analyst_log* application is implemented in the public domain Tcl/Tk and is located in `$CMS_SCRIPTS/bin/analyst_log`. *analyst_log* is started from the CDE toolbar by the `$CMS_SCRIPTS/bin/start` script. *analyst_log* does not take command line arguments, but is programmed to access the par file:

```
$CMS_CONFIG/app_config/interactive/analyst_log/analyst_log.par
```

which in turn accesses the files:

```
$CMS_CONFIG/system_specs/process.par
$CMS_CONFIG/system_specs/interactive.par
```

In the course of running, *analyst_log* executes the following scripts:

```
$CMS_SCRIPTS/bin/rebqc
$CMS_SCRIPTS/bin/ARSscan
$CMS_SCRIPTS/bin/today
$CMS_HOME/contrib/bin/mon_dd
$CMS_HOME/contrib/bin/qcmap
```

The only database table *analyst_log* accesses is LEB:**allocate_hour**. *analyst_log* accesses the icon file `$CMS_CONFIG/app_config/interactive/analyst_log/analyst_log.ppm`. It does not use X resources.

INITIATING OPERATIONS

Before initiating the Interactive Analysis software, verify that the following installation and configuration steps have been completed:

- The hardware infrastructure is physically configured.
- The COTS and PD third-party software is installed and configured.
- The database server is installed and configured.
- Disk directories for waveform data and application log files are allocated.
- The configuration directory tree is installed.
- Analyst workstations are configured for Tuxedo IPC.

- Analyst login accounts are configured.
- Input waveform data and database tables are generated.

When the installation and configuration process is complete, initiate an analysis session as described in "Software Startup" on page 18. Validate the Interactive Analysis software, as described in the next section.

VALIDATING INSTALLATION

The Interactive Analysis software can be validated in three stages. In the first stage, the functions of the individual applications are systematically exercised using a fixed data set or reference database configuration. In the second stage, standard analyst procedures are followed, implicitly testing the interactive analysis tools. A number of 2-hour time blocks are analyzed and one of these time blocks is scanned for missing events. Either a fixed data set or operational output of the automatic processing subsystem may be used. The final validation test is successful generation of a REB for a complete data day.

Table 32 is an example of a basic Interactive Subsystem validation test.

TABLE 32: EXAMPLE INTERACTIVE VALIDATION TEST

Application	Validation Procedure
analyst_log	Keep a log of problems observed in *analyst_log* during normal usage.
	Verify *analyst_log* starts from CDE toolbar.
	Allocate a time period and perform *ARSscan*.
	Verify that three *dman/ARS* sessions using different agents can be launched from *analyst_log*.
	Initiate recall processing after analyzing events in automatic event list.
	Initiate recall processing after scanning.
dman	Keep a log of problems observed in dman during normal usage.
	Verify that dman can launch and terminate applications and track their messaging.

TABLE 32: EXAMPLE INTERACTIVE VALIDATION TEST (CONTINUED)

Application	Validation Procedure
ARS	Keep a log of problems observed in *ARS* during normal usage.
	Use *ARS* to display waveforms, arrivals, and origins from automatic processing.
	Use *ARS* to modify arrivals, reassociate phases, and relocate and save events.
	Use *ARS* to send messages to *XfkDisplay, Map, AEQ, SpectraPlot, PolariPlot* and *DFX*.
	Run interactive *DFX* on six added depth phases.
	Use *ARS* to display M_L parameters.
	Use quick-tip labels for buttons in *ARS*.
	Use quick-tip labels to identify hydroacoustic groups
AEQ	Keep a log of problems observed in *AEQ* during normal usage.
	Verify that *AEQ* correctly flags events with deliberately anomalous attributes.
HART	Keep a log of problems observed in *HART* during normal usage.
	Use *HART* to display and modify azimuth on five hydroacoustic groups.
IADR	Keep a log of problems observed in *IADR* during normal usage.
	Verify that auxiliary data can be requested interactively for three events.
Map	Keep a log of problems observed in *Map* during normal usage.
	Use *Map* to display origins, origin errors and associations.
PolariPlot	Keep a log of problems observed in *PolariPlot* during normal usage.
	Use *PolariPlot* to display polarization analysis results of five 3-C stations.
SpectraPlot	Keep a log of problems observed in *SpectraPlot* during normal usage.
	Use *SpectraPlot* to display the spectrum of selected stations.

TABLE 32: EXAMPLE INTERACTIVE VALIDATION TEST (CONTINUED)

Application	Validation Procedure
XfkDisplay	Keep a log of problems observed in *XfkDisplay* during normal usage.
	Use *XfkDisplay* to compute the FK of each primary station, and selected auxiliary stations.
	Use *XfkDisplay* to compute the FK of each infrasound station.
	Use *XfkDisplay* to send back computed azimuth and slowness to *ARS*.
	Use *XfkDisplay* to compute and send an FK beam.

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Glossary

Symbols

3-C

Three-component.

A

AEQ

Anomalous Event Qualifier.

align

Adjust the time offset of waveform data so that the theoretical arrival times for phases associated to an event align vertically on the *ARS* waveform display.

AlphaList

(*ARS*) List of stations and phases contributing to an S/H/I event location.

analyst

Personnel responsible for reviewing and revising the results of automatic processing.

arid

Arrival identifier.

array

Collection of sensors distributed over a finite area (usually in a cross, triangle, or concentric pattern) and referred to as a single station.

arrival

Signal that has been associated to an event. First, the Global Association (GA) software associates the signal to an event. Later during interactive processing, many arrivals are confirmed and improved by visual inspection.

ARS

Analyst Review Station. This application provides tools for a human analyst to refine and improve the event bulletin by interactive analysis.

associate

Assign an arrival to an S/H/I event.

associated phase

Phase that is associated with an S/H/I event.

attribute

(1) Database column. (2) Characteristic of an item; specifically, a quantitative measure of a S/H/I arrival such as azimuth, slowness, period, or amplitude.

azimuth

Direction, in degrees clockwise with respect to North, from a station to an event.

B

back azimuth

Direction, in degrees, from an event to the station.

background noise

Natural movements of the earth, oceans, and atmosphere as seen on S/H/I sensors (usually measured in data preceding signals).

background processing

Execution of a low-priority process while higher priority processes are not using computer resources; also, the execution of processes that do not require user interaction.

beam

(1) Waveform created from array station elements that are sequentially summed after being steered to the direction of a specified azimuth and slowness. (2) Any derived waveform (for example, a filtered waveform).

beamform

Sum a set of waveforms from array station elements with time delays introduced to compensate for the time it takes a wave to travel across the array.

blockage (hydroacoustic)

Obstruction in the direct oceanic path between the source and the receiver.

BOTF

Beam-on-the-Fly processing. A *DFX* Scheme application that creates origin beams and can be called from within *ARS*.

build

(1) To create an event by detecting its seismic or hydroacoustic signals, associating its arrivals, identifying them as phases, and locating the event. (2) An operational version of a system or component that incorporates a specified subset of the capabilities that the final product will provide.

bulletin

Chronological listing of event origins spanning an interval of time. Often, the specification of each origin or event is accompanied by the event's arrivals and sometimes with the event's waveforms.

C

CDE

Common Desktop Environment.

channel

Component of motion or distinct stream of data.

click

Select an element on the screen by positioning the pointer over the element, then pressing and immediately releasing the mouse button.

coda

Signal of a given phase, which follows the initial waveform of that phase.

coda phase

Detection found within the envelope of a single phase; an otherwise unidentified phase of unknown path designated as tx, Px, Hx, Tx, Ix, or Sx.

coherent

Quality of having a fixed phase relationship; as signals from a wavefront detected on numerous seismic or infrasonic array station elements.

coherent beam

Beam formed from unrectified waveform data (usually zero-meaned), which utilizes phase information in the waveform to enhance coherent energy at the azimuth and slowness of the beam and to suppress random noise.

command

Expression that can be input to a computer system to initiate an action or affect the execution of a computer program.

Common Desktop Environment

Desktop graphical user interface that comes with SUN Solaris.

component

(1) One dimension of a three-dimensional signal; (2) The vertically or horizontally oriented (north or east) sensor of a station used to measure the dimension; (3) One of the parts of a system; also referred to as a module or unit.

Computer Software Component

Functionally or logically distinct part of a computer software configuration item, typically an aggregate of two or more software units.

Computer Software Configuration Item

Aggregation of software that is designated for configuration management and treated as a single entity in the configuration management process.

configuration

(1) (hardware) Arrangement of a computer system or components as defined by the number, nature, and interconnection of its parts. (2) (software) Set of adjustable parameters, usually stored in files, which control the behavior of applications at run time.

CPU

Central Processing Unit.

crash

Sudden and complete failure of a computer system or component.

CSC

Computer Software Component.

CSCI

Computer Software Configuration Item.

cvar

Variable accessible to the C programming language. Specifically, cvars are name-value pairs of character strings implemented in the C code.

D

DACS

Distributed Application Control System. This software supports inter-application message passing and process management.

dataday

One analysis day or 24 hours of S/H/I analysis; the time period covered by one event bulletin.

defining

Arrival attribute, such as arrival time, azimuth, or slowness, which is used in calculating the event's location or magnitude.

defining phase

Associated phase for which features are used in the estimation of the location and origin time of an S/H/I event.

deg.

Degrees (as a distance).

depth phase

Seismic signal that travels upwards from the hypocenter, reflects off the earth's surface, and travels the remaining path as a typical refracted phase. It is usually denoted by a phase name starting with a lower case "p" or "s" that indicates the upward leg of the path.

desktop

Display area on an analysis workstation where all application windows are displayed.

detection

Probable signal that has been automatically detected by the Detection and Feature Extraction (*DFX*) software.

detection beam

Same as a f-k beam.

DFX

Detection and Feature Extraction. *DFX* is a programming environment that executes applications written in Scheme (known as *DFX* applications).

dman

Distributed Application Manager. This software element of the DACS manages the availability (execution) of processes.

E

element

Single station or substation of an array, referred to by its element name (such as YKR8), as opposed to its array name (YKA in this example).

energy

Occurrence that displays characteristics indicative of a possible nuclear weapons test.

event

Unique source of seismic, hydroacoustic, or infrasonic wave energy that is limited in both time and space.

event definition criteria

Rules that specify the minimum number and type of defining phases or stations that are required to define an event.

evid

Event identifier.

F

f-k

Frequency versus wavenumber (k) analysis that maps phase power from an array as a function of azimuth and slowness.

f-k beam

Coherent beam steered to the azimuth and slowness of the maximum peak in an f-k spectrum.

f-k spectrum

Result of a data transformation from the time-space domain to the frequency-wavenumber domain. Useful in determining the direction and slowness of an arriving phase.

failure

Inability of a system or component to perform its required functions within specified performance requirements.

false event

Term used to describe events that are not real or have been built by associating noise or nonseismic detections.

features

Various measurements of a waveform segment used to characterize a detection.

H

HAG

Acronym for Hydroacoustic Arrival Group used in hydroacoustic processing.

hydroacoustic

Pertaining to sound in the ocean.

I

iconify

Minimize an application display window so that only a recognizable graphic symbol or icon occupies space on the display.

ID

Identification; identifier.

IDC

International Data Centre.

IMS

International Monitoring System.

infrasonic (infrasound)

Pertaining to low-frequency (sub-audible) sound in the atmosphere.

IPC

Interprocess communication. The messaging system by which applications communicate with each other through *libipc* common library functions. See *tuxshell*.

J

JRE

Acronym for Java run-time environment, the software application in which a Java application runs.

K

km

Kilometer.

L

lat.

Latitude.

LEB

Late Event Bulletin; a list of analyst reviewed S/H/I events and event parameters (origin and associated arrival information).

logon

Process of a computer user identifying themselves by means of a user ID and password to a computer operating system as a registered user, beginning an interactive session.

logout

Ending or exiting a computer user session.

long.

Longitude.

M

magnitude

Empirical measure of the size of an event (usually made on a log scale).

Map

Application for displaying S/H/I events, stations, and other information on geographical maps.

m_b

Magnitude estimated from seismic body waves.

M_L

Magnitude estimated from waves measured near the source.

monitoring system

See IMS.

N

network

Spatially distributed collection of seismic, hydroacoustic, or infrasonic stations for which the station spacing is much larger than a wavelength.

nm

Nanometer.

noise

Incoherent natural or artificial perturbations of the waveform trace caused by ice, animals migrations, cultural activity, equipment malfunctions or interruption of satellite communication, or ambient background movements.

nondefining

Arrival attribute, such as arrival time, azimuth, or slowness, which is associated, but not used in calculating the event's location or magnitude.

nondefining phase

Associated phase for which features are not used in estimating the location and origin time of an S/H/I event.

O

ORACLE

Vendor of the database management system used at the PIDC and IDC.

orid

Origin Identifier.

origin

Hypothesized time and location of a seismic, hydroacoustic, or infrasonic event. Any event may have many origins. Characteristics such as magnitudes and error estimates may be associated with an origin.

P

period

Average duration of one cycle of a phase, in seconds per cycle.

phase

Arrival that is identified based on its path through the earth.

phase name

Name assigned to a seismic, hydroacoustic or infrasonic arrival associated with a travel path.

PIDC

Prototype International Data Centre.

pipeline

1) Flow of data at the IDC from the receipt of communications to the final automated processed data before analyst review. 2) Sequence of IDC processes controlled by the DACS that either produce a specific product (such as a Standard Event LIst) or perform a general task (such as station processing).

PKP phase

Seismic compressional wave that travels from the event to the station as a compressional wave through the crust, mantle, and outer core.

polarity

Direction of first motion on a seismogram; either up (compression) or down (dilatation or relaxation).

polarity reversal

Occurrence of depth-phase waveforms that are mirror images of the initial P-type phases

polarization

Form of three-component analysis used to derive azimuth and slowness information from non-array stations.

polarization analysis

Analysis to determine the propagation vector that describes particle motion. Used at seismic 3-C stations.

pop-up

Small window that contains selectable objects such as filter settings.

primary phase

First arriving phase recorded at a S/H/I station.

primary seismic

IMS seismic station(s) or data that is (are) part of the detection network.

primary stations

Stations that make up the primary seismic network of the IMS. Primary stations send data continuously to the IDC.

probability of detection

Probability estimate that an arrival from a given event will be detected at a station given the location and magnitude of the event, the average noise level and its standard deviation at the station, and the signal-to-noise detection threshold.

process

Function or set of functions in an application that perform a task.

processing unit

Software component of a larger entity such as a program.

product

Bulletins, data, and other information collected, produced, and distributed by the IDC.

pull-down

Small list of selectable objects such as menu items, which appears below a menu heading.

Q

QC

Quality Control.

query

Request for specific data from a database.

QuickTip

Pop-up informational message identifying or explaining a user interface item such as a menu item or function button. QuickTips display when the user hovers the mouse cursor over the interface item.

R

RAM

Random Access Memory.

raw waveform

Waveform data as they are received from a station.

REB

Reviewed Event Bulletin; the bulletin formed of all S/H/I events that have passed analyst inspection and quality assurance review.

recall processing

Type of *DFX* processing that updates arrival features based on changes made during analyst review.

recipe

Collection of related parameters used in performing a specific task. Recipe parameters are usually defined in par files.

recovery

Restoration of a system, program, database, or other system resource to a state in which it can perform required functions.

regional

(1) (distance) Source to seismometer separations between a few degrees and 20 degrees. (2) (event) Recorded at distances where the first P and S waves from shallow events have traveled along paths through the uppermost mantle.

residual

Difference in time, azimuth, or slowness between a calculated attribute and its corresponding theoretical value.

run

(1) Single, usually continuous, execution of a computer program. (2) To execute a computer program.

S

s

Second(s) (time).

S/H/I

Seismic, hydroacoustic, and infrasonic.

SAIC

Science Applications International Corporation.

save

Store an analyzed event to the final database, thereby preventing further changes to the event.

sbsnr

Signal-to-noise ratio measured on a standard beam.

scan

Systematically view all waveforms and seek out possible events missed by the automated system.

schema

Database structure description.

Scheme

Dialect of the Lisp programming language that is used to configure some IDC software.

script

Small executable program, written with UNIX and other related commands, that does not need to be compiled.

seaz

Station-to-event azimuth. Usually predicted from the origin location except in the **detection** table where it is estimated from the data.

seismic

Pertaining to elastic waves traveling through the earth.

SEL3

Standard Event List 3; S/H/I bulletin created by totally automatic analysis of both continuous data and segments of data specifically down-loaded from stations of the auxiliary seismic network. Typically, the list runs 12 hours behind real time.

select

To choose an element on the screen by clicking on it with the mouse pointer.

site

Location of a sensor within a station.

slowness

Inverse of velocity, in seconds/degree; a large slowness has a low velocity.

snr

Signal-to-noise ratio.

Solaris

Name of the operating system used on Sun Microsystems hardware.

spectrum (spectral)

Plot of the energy contained in waveforms as a function of frequency.

standard beam

Beam in which the delays between stations are based on a pre-defined set of recipe parameters (referred to as the standard recipe parameters).

States Parties

Treaty user group who will operate their own or cooperative facilities, which may be National Data Centres.

station

Collection of one or more monitoring instruments. Stations can have either one sensor location (for example, BGCA) or a spatially distributed array of sensors (for example, ASAR).

surface wave

Seismic wave propagating along the surface of the earth.

T

teleseismic

1) (distance) Source to seismometer separations of 20 degrees or more. (2) (event) Recorded at distances where the first P and S waves from shallow events have traveled paths through the mantle/core.

theoretical arrival

Point where an arrival is expected to appear on a waveform, based on an event's location and depth.

time series

Time ordered sequence of data samples. Typically a waveform or derived from waveforms.

transient signal

Packet of energy of finite duration that stands out from the background ambient noise.

trigger

(1) Action a database should take when some database-related event occurs. (2) Object used in *DFX* to indicate a potential transient signal for a given beam. Triggers for a set of beams are collected to form detections.

tuxshell

Process in the Distributed Processing CSCI used to execute and manage applications. See IPC.

U

uncertainty

Estimate of the deviation from the true mean for the parameter or variable of interest.

unfreeze

Allowing a saved event to be reanalyzed by removing it from the final database.

UNIX

Trade name of the operating system used by the Sun workstations.

W

waveform

Time-domain signal data from a sensor (the voltage output) where the voltage has been converted to a digital count (which is monotonic with the amplitude of the stimulus to which the sensor responds).

wavenumber

Vector, *k*, in the direction of a propagating wave whose magnitude is given by the inverse wavelength of the wave scaled by a factor of 2π.

workstation

High-end, powerful desktop computer preferred for graphics and usually networked.

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